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FIRST LOOKS

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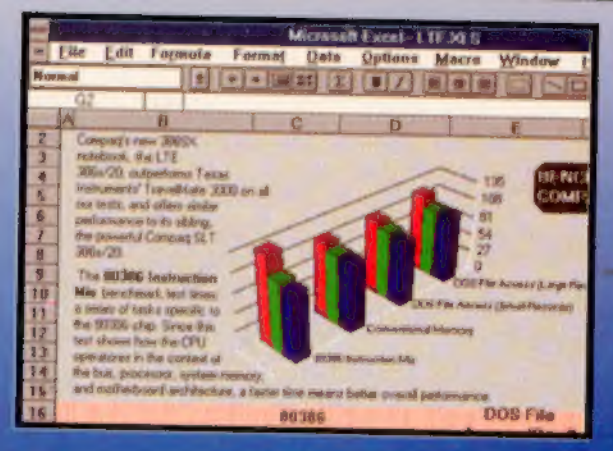

AFTER HOURS

The Latest Tax Software: Better Than the Programs Used by the Pros?

FREE UTILITY

Dupe Floppies Fast, Compress Multiple Files with This Pair of Programs

MARCH 12, 1991 THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOLUME 10 NUMBER 5

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Portable Power

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- 9 Affordable 286 Notebooks: Everyday Companions
- 23 SX and 386 Laptops: Full Power, Small Packages
- 6 Desktop-Strength AC-Only 386 Luggables

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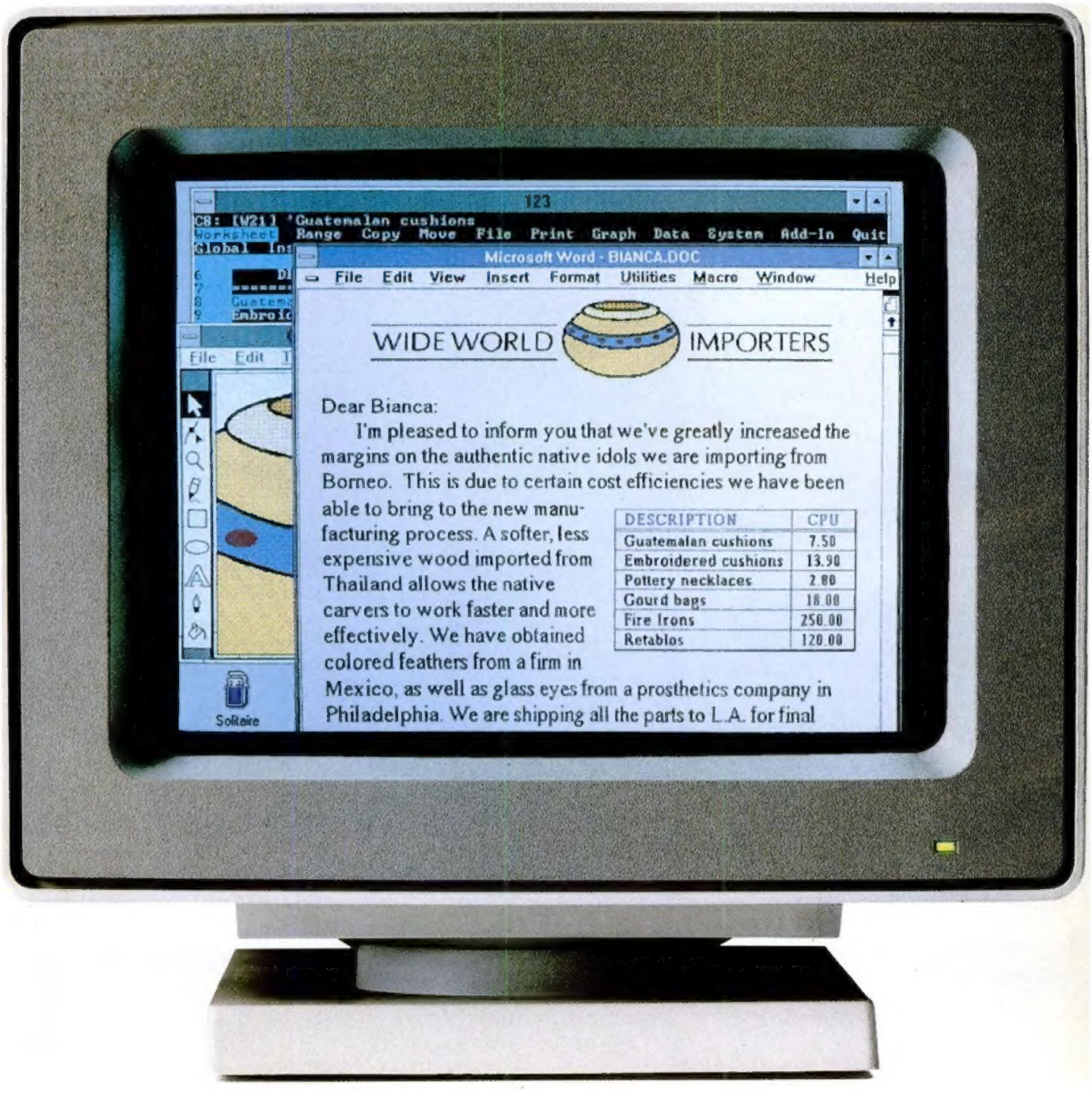

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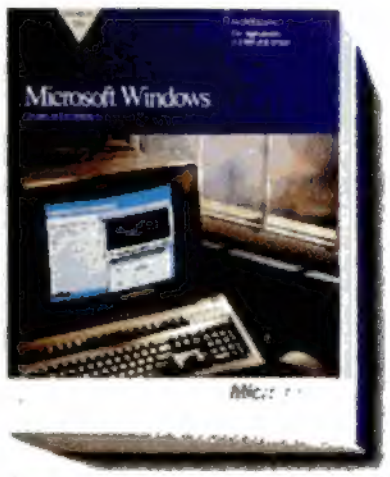

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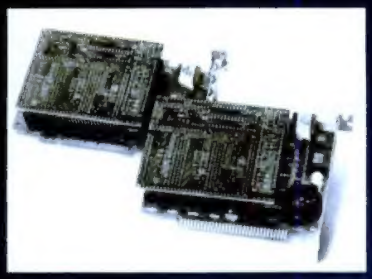

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CIRCLE 173 ON READER SERVICE CARD

Inside

Four years ago, when leading-edge laptops had leisurely 8088 processors, low-contrast CGA displays, and 12- to 15-pound travel weights, *PC Magazine* drafted a wish list for "The Perfect Portable": a 5-pound, notebook-size, battery-powered unit with an illuminated 10-inch VGA display. Estimated price with a modem and 20MB hard disk: $2,600. Four years later, that blueprint from the July 21, 1987, issue essentially parallels the specifications characterizing Editors' Choice portables in this issue.

The creator of the ideal-laptop proposal in 1987 was executive editor Bill Howard, who writes the introduction to this single-topic issue reviewing 42 notebook, laptop, and portable computers. Since joining the staff in 1985, Howard has become *PC Magazine*'s resident guru on DOS-to-travel technology. His articles on laptop computers have won first-place awards in the Computer Press Association competition for the past two years, and he's currently completing a book, *The PC Magazine Guide to Notebook and Laptop Computers*.

"Laptops and notebooks now pack virtually all the power of a desktop computer," says Howard. "Today you don't need a second computer for the road. Your portable can be your desktop computer, too.

"The most impressive advances have been in weight and size reduction. Four years ago, no one would have imagined 20- to 60MB hard disks weighing less than 10 ounces. The biggest disappointment has been the snail's pace of battery technology. Most progress came from reducing power consumption rather than increasing battery output."

What's still missing from the picture? Great color. "Passive matrix color displays are affordable, but the quality is disappointing. The active matrix displays just cost too much," Howard says. "And we're still several years away from seeing color LCDs that can run off batteries."

Portable PC guru Bill Howard reports on how far the laptop industry has come, and how much farther there is to go.

In this, our second annual portables-only issue, you'll read about computers ranging from lightweight (in every sense of the word) 8088/8086s to a powerful 486 AC-only luggable.

In the early stages of researching this issue, *PC Magazine* came across more than 350 vendors of portable computers. We whittled this number down by setting the same criteria we believe you'd use: Low-power 8086 and 80286 portables had to be small and light. AC-only units had to have heavy-duty 386 processing power to justify carrying around a 20-pound box. And finally, every portable either had to have FCC Class B certification or be in the final stages of the approval process. **—Julie Cohen** ■

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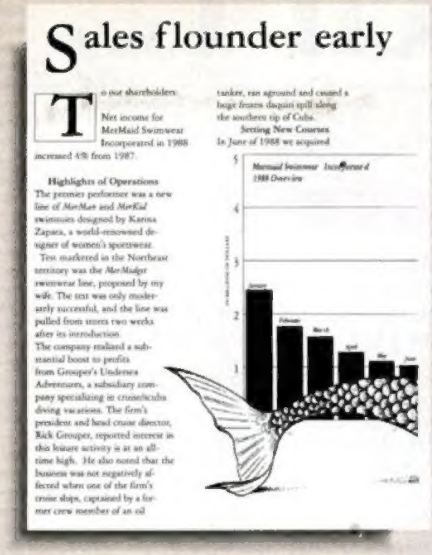

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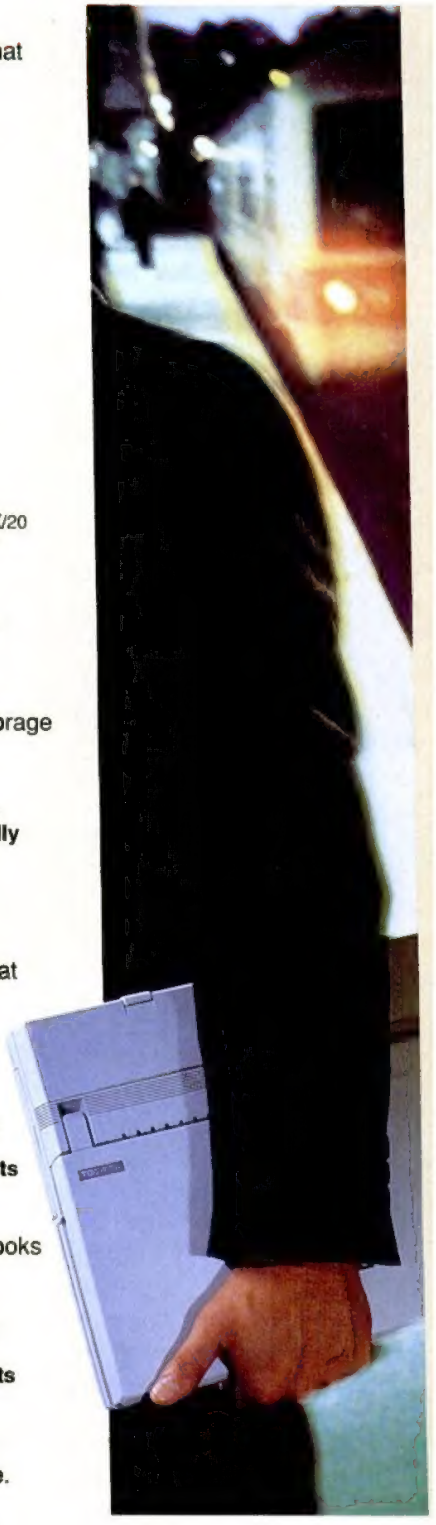

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"Austin's 386/25 WinStation is a system loaded with value, with the added benefit of top-level customer service and support policies."-*PC Magazine* 386/25 Editor's Choice Review

"Austin Computer Systems is on a roll. . .the Austin, Texas-based computer seller has garnered *PC Magazine's* Editor's Choices as if the award had been created for it."-Frederic Burke, *PC Magazine* Computer Consultant

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-*Computer Shopper,* April 1990 Issue

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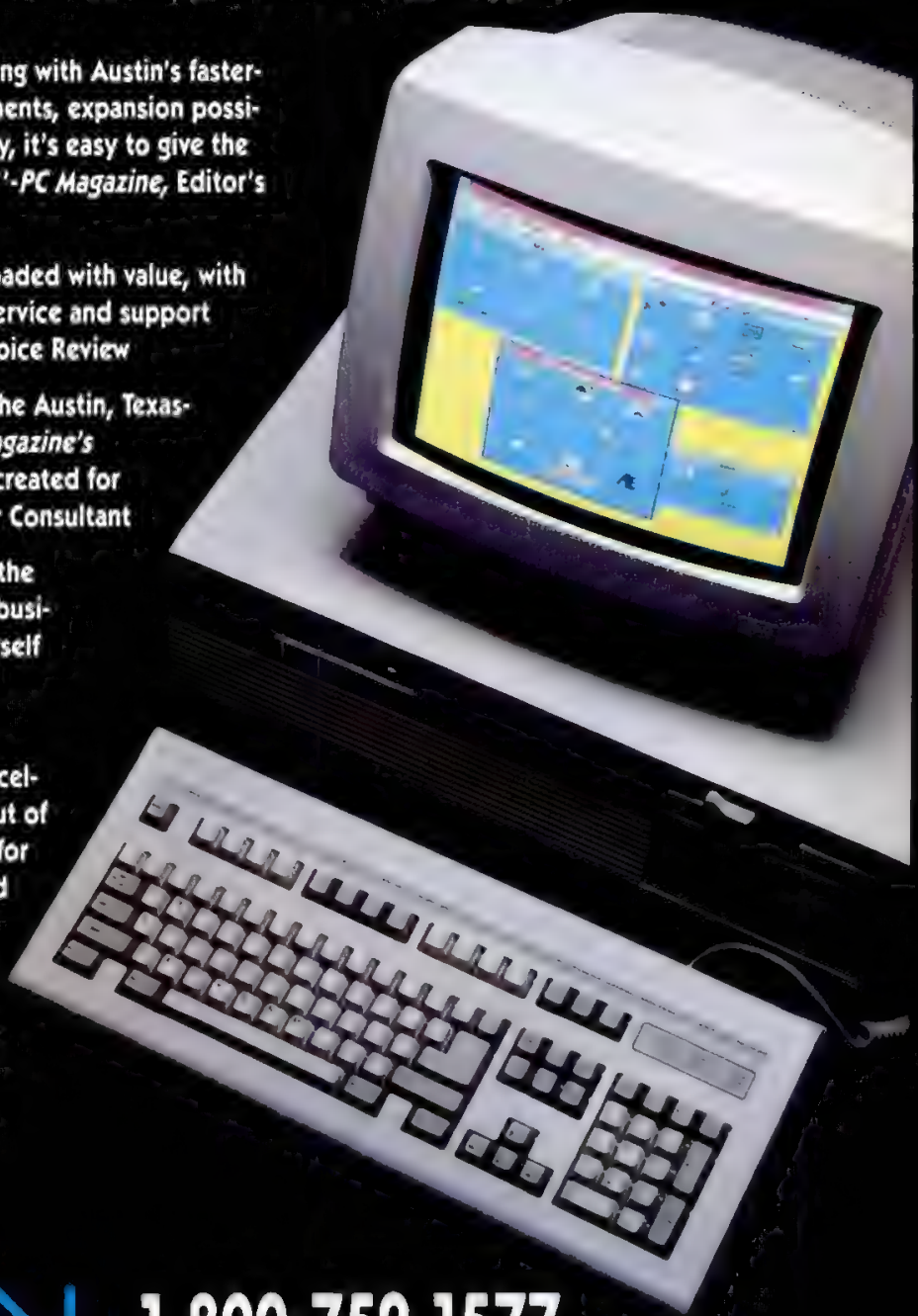

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- Super-Charged VGA Video Adapter with 512K VRAM
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- Microsoft Mouse
- Complete System only $2890!

AUSTIN 386/25 WINSTATION

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- 7 Expansion Slots (1 8-bit and 6 16-bit)
- 80387 Math Coprocessor Socket
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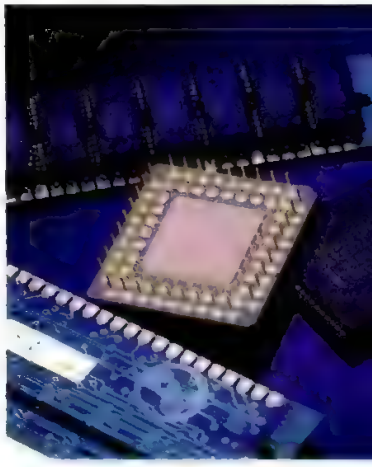

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HIGHLIGHTS

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PC MAGAZINE EDITOR'S CHOICE

FCC Class B

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- 7 Expansion Slots (1 8-bit and 6 16-bit)
- 80387/SX Math Coprocessor Socket
- 1 Parallel and 2 Serial Ports
- Enhanced 101 Keyboard with Tactile/Click Touch
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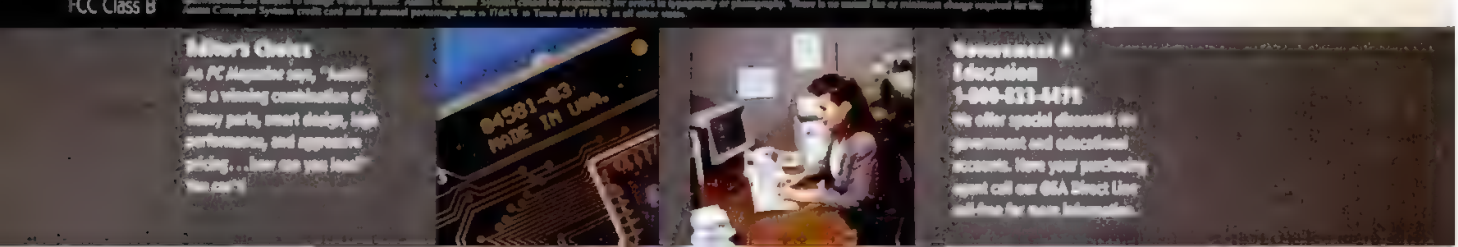

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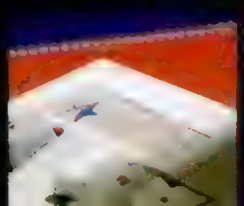

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PC MAGAZINE EDITORS' CHOICE October 30, 1990 Software Carousel Version 4.0

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And OLÉ works with all kinds of connection software. Including IBM, Attachmate, and others. Without changes to your hardware or software.

Even the experts agree.

Garry Ray, writing for PC Week, said, "Of these alternative operating environments (OS/2, DesqView and Software Carousel), Carousel may be the best choice of the day."

Barry Simon of PC Magazine concurred with, "...I find it difficult to imagine using my computer without Carousel. This package has become an essential tool and one that I strongly recommend."

So if you really want the major benefits of Windows and OS/2, don't get grounded with high cost and mind-bending complexity. Take off today with Software Carousel. It's easy. And it's just $89.95.

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*Open Link Extender is sold separately. †Requires NetBIOS connection.

#6

Letters

ARE YOU LISTENING BILL GATES?

I agree 100 percent with Charles Petzold ("Computing in the 1990s," November 27, 1990). I have written applications for both Presentation Manager and *Microsoft Windows* and I am starting to get into X on a Unix system. In my opinion, Presentation Manager as the GUI and OS/2 as the operating system is a superior combination.

While it is certainly true that the PM GPI graphical interface is more robust than the *Windows* GDI interface, the primary reason for my choice is the ability to write multithreaded applications. I believe that, except perhaps for reading and writing primary data files, the user should never have to wait for one command to be carried out before giving a second.

I am upset with both Microsoft and IBM for failing to promote and support OS/2 and PM, and even more upset with the extreme hype over *Windows* 3.0. There is very little driver support for OS/2 while *Windows* has hundreds of drivers. OS/2 2.0, a true 32-bit operating system with a flat address space and the ability to run old DOS tasks transparently to the user, should have been out a year ago. Who cares if it won't run on a 286—is anybody buying 286s anymore anyway? Come on, Bill Gates, look beyond next week!

Joseph C. Krupp
Arlington, Virginia

Is *Windows* merely a stepping stone to OS/2? The technical arguments are overwhelming: No matter how you slice it, *Windows* is an extension of DOS, and DOS is a dinosaur. 32-bit buses, 2 to 4 megabytes of RAM, and 80-plus megabyte hard disk drives are rapidly becoming standard in desktop PCs. DOS just can't make efficient use of them.

Unfortunately, marketing and logic are two different things, and marketing wins every time. Witness the fate of the Edsel, Beta VCRs, and Michael Dukakis.

David A. Welch
Toronto, Ontario, Canada

OS/2 or *Windows*? Who will win?

ILLUSTRATION: JOHN LABBE

I read with great interest Charles Petzold's comments on *Windows* 3.0, where he explained why *Win* 3 will never be as stable as OS/2 because it is highly vulnerable to misbehaving applications.

As Petzold points out, when a single-tasking DOS program goes south, at most you lose the data in that one application; under *Windows*, a catastrophic crash can destroy data in multiple programs at once. For this reason, I implore vendors to show more responsibility and not ship *Windows* apps until they're reasonably sure they've eliminated all fatal bugs. Otherwise, *Win* 3 may soon develop a reputation not as the premier multitasking operating environment, but as the foremost "multihanging" one.

Dan Zoll
Bethesda, Maryland

Yes, it may be true that *Windows* is only a short-term solution. But it is here, *now*. Mr. Petzold extols the advantages of OS/2 2.0 over *Windows* 3.0. But are they here, available, right now?

What we have here is the *promise* of OS/2 versus a real, functional, available *Windows* 3.0. When I can go out and buy a version of OS/2 that can do what *Windows* 3.0 does now, maybe I'll buy it. But for *right now*, *Windows* 3.0 is the best answer.

Dan Thomas
Placentia, California

Charles Petzold's November 27 column doesn't carry the argument far enough. Mr. Petzold cites figures to show an exponential increase in the amount of physical memory on a typical PC. Unfortunately, the same growth pattern has been manifested in the size of individual applications. The problem of RAM cram will soon be replaced by the problem of Virtual cram.

Even if current trends slow down moderately, a 32-bit address is not going to hack it for very long. In fact, even if Intel puts a segment-translation cache on its newer chips and OS/2 and Unix are upgraded to use 48-bit (16+32) addresses, that will only be a stopgap. We need 64-bit addressing within our lifetimes.

Seymour Metz
Annandale, Virginia

PRETTY DOESN'T ALWAYS DO

I agree 100 percent with Paul Stapleton's view of your 3-D bar charts. While very pleasing aesthetically, functionally they leave a lot to be desired. As a matter of comparison, a simple 2-D bar chart would be much better.

Philip G. Mollica
Holly, Michigan

DVORAK'S FORMULA FAILS

I read with horror John C. Dvorak's personal opinion of what America wants ("A Formula for Failure," November 27, 1990). His explanation of the technical difficulties of creating such a device (due to the use of opposite charges on the drums of laser printers and photocopiers) displays a complete lack of understanding. John, if you can scan an image and you can print it, you *have* a photocopier!

Dvorak describes how a failure in one

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CIRCLE 726 ON READER SERVICE CARD

Letters

part of such a machine may put the entire unit out of commission. This is true, but for the average person the same is true for any card put inside their system.

Dvorak didn't have the idea for this device himself, and it seems like he's feeling "sour grapes" about it.

David Shadoff
Mississauga, Ontario, Canada

I found John C. Dvorak's comments on the integrated scanner/printer/fax/copier concept to be provocative, to say the least. But if no one would be interested, why does he keep hearing about it? For one, I would be interested. If I can replace four separate devices with one, and save some hard-earned money in the process, it is meaningful to me.

I am sorry to hear that Dvorak feels that the opposite charge problem will keep the concept from working. Don't worry, John. While you are sitting there twiddling your thumbs saying it can't be done, some innovative Japanese engineers will solve the problem.

Peter F. Wells
Rindge, New Hampshire

John C. Dvorak may be right that we don't want to buy integrated, but a combo laser printer/photocopier would sure help me.

I have 30 drawers of file cabinets, two desks with credenzas, two computers, a printer, typewriter, fax, two telephones, postage meter and scale, three bookshelves, and a laptop in the corner—and all in my third bedroom/office. I need a copier, but where will I put it?

Jeffrey J. Denning
Long Beach, California

OKAY, ONE LAST "SOFTWARE IN FLAMES" LETTER

This is one way of thinking of it: If I lose my credit card, the company will give me a new one. I don't actually *own* the credit card, I'm just using it. If the company decides that I can't use it wisely, they'll repossess it. If I just have the *right* to use my software and my credit card, and the companies can take the rights away, and if I can get a new credit card if I lose mine, why shouldn't I get another copy of my software if I lose it in a fire?

In the November 13, 1990, issue, Mitch Barrie states that neither he (he's in the LAN hardware business) nor a car company would give someone a cheap replacement because of a fire. That I can understand. Hardware is expensive. Software is cheap to make another copy. If all we have is the right to use it, why shouldn't we be able to get another copy?

Paul Gibson
Grantham, Pennsylvania

> Ahhhhhhh, it's that thick, syrupy performance of *Windows* 3.0 on a 386 that really takes me back.

PC MAGAZINE And I suppose it's okay for the software company to come and repossess your software when you don't use it responsibly too?—*Ed.*

OOEY GUI

In the October 30, 1990, issue, the venerable Ray Duncan tackles the question of how DOS should be improved. While I agree totally with most of Mr. Duncan's proposals, I must vehemently disagree with one of them: his belief that DOS "needs" a GUI—in the form of *Windows* 3.0.

I'm neither a GUI-basher, nor a GUI-pusher. I think they have their place. One thing I am is performance-minded! If I ever feel the need at work to get back to the "feel" of the 1984 no-name XT clone I still have at home, it's no problem—I run *Windows*. Certainly, the screen's a lot prettier than DOS, and many of the capabilities show great promise. But ahhhhhhhhh, its that thick, syrupy performance of *Windows* 3.0 on a 386 that really takes me back.

I'll be more than happy to recommend the GUI as an add-on for those who need or want it—I may even want it some day. But for now, give me a well-done mouse-driven character-based interface (without all the overhead) that's blazing fast!!

Michael L. Hoelscher
Tacoma, Washington

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2) **Screen: "VGA-compatible screen that has a dark-and-bold font that is unusually sharp."**
3) **Battery: "No other system in this comparison (Compaq nor Toshiba) supports a battery."**
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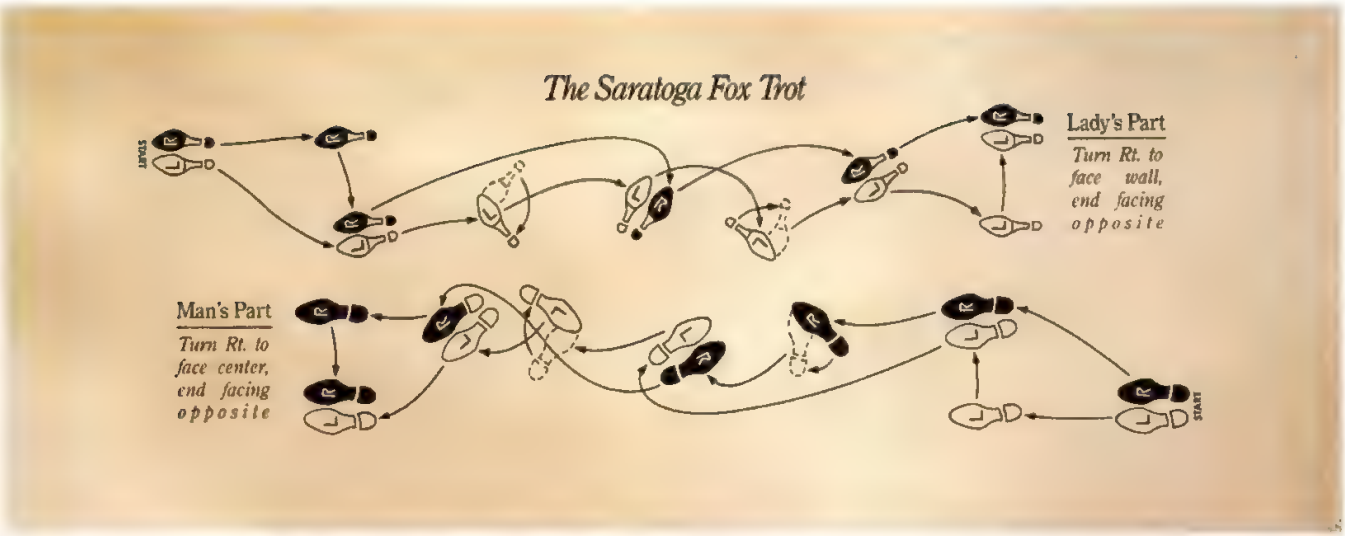

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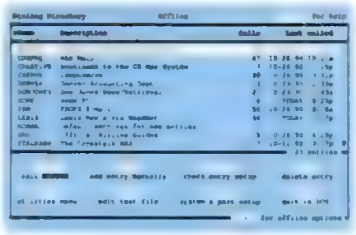

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CIRCLE 278 ON READER SERVICE CARD

Letters

WAKE UP MADISON AVENUE!
I know, I know! Your magazine has to have little 3-by-5 cardboard inserts, full-page (but slightly narrow) thick cardboard inserts, double foldover glossy pages, glossy triple front page foldovers, and entire catalogs inserted, etc., etc., ad nauseum. It takes me almost 10 minutes to tear them all out!

How about something new and clever. The Madison Avenue people have got to be able to come up with something better than little colored cards that fall on the floor so you have to pick them up to throw them out. Maybe *PC Magazine* could put all the ads of a particular item in one section, and label the section. I can only dream of turning to your magazine next time I need a keyboard, flipping to that advertising section, and browsing over only keyboard ads. Heaven!

The obvious offshoot of this would be that your articles would be all in one section. Better than heaven! It is only a small complaint, but I'll bet a cup of coffee that if you ask your readers, this would be their number-one gripe.

Co Crocker
Farmington, Connecticut

MISSING MIDI
I have recently decided to upgrade some MIDI (Musical Instrument Digital Interface) software and have found that finding reviews and the vendors is almost painfully difficult. I seem to remember that several years ago you published an article on personal computers, music, and MIDI, when MIDI was still in its relative infancy.

I would greatly appreciate it if you could do another roundup of MIDI software. I realize that we are talking about some rather specialized software, but spending $400 to $600 (or more) and finding out that the software does not really do what I want is an expensive proposition that I would rather live without.

Herve T. Mann
Harrisburg, Pennsylvania

In our After Hours columns of November 13 and December 25, 1990, we reviewed some MIDI products. As of now, a full-length roundup is not scheduled.—*Ed.*

WORD FAILURE
I enjoyed reading your cover story about word processors in the December 11, 1990, issue, but you failed to point out one very important bug in *Word for Windows* 1.1. *Word for Windows* does not handle subscripting appropriately.

Instead of taking the subscripted character and placing it in the normal lowered position, this program keeps the subscript stationary and forces the whole line up. If you have multiple subscripts on a page, the printed output looks terrible.

I was told by Microsoft that the reason is that the program handles line spacing according to the lowest portion of the line, which in this case is the subscript, and perhaps it will be corrected in the future.

I tend to doubt that, since *Microsoft Word* for the Mac does the same thing and has gone through four major revisions. Until things are corrected, *Ami Professional* is my first choice.

John Roy
Willow Grove, Pennsylvania

Word for Windows' line spacing is notoriously awkward, and the workaround is almost impossible to find in the manual. To maintain consistent line spacing with superscripts or subscripts, enter the line spacing measurement in the Format Paragraph dialogue box, with a minus sign before the number.—*Ed.*

In your December 11, 1990, cover story on word processors, you left out an excellent program: Ann Arbor Software's *Textra* 6.0.

For only $95, *Textra* provides many features that you would expect only to find in a high-end word processor. It has extensive help screens, stylesheets, advanced formatting, spell-checking, a thesaurus, mail merge, macros, line/box drawing, and allows graphics insertion in documents.

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Donald Taylor
Tampa, Florida

HOW TO WRITE TO PC MAGAZINE

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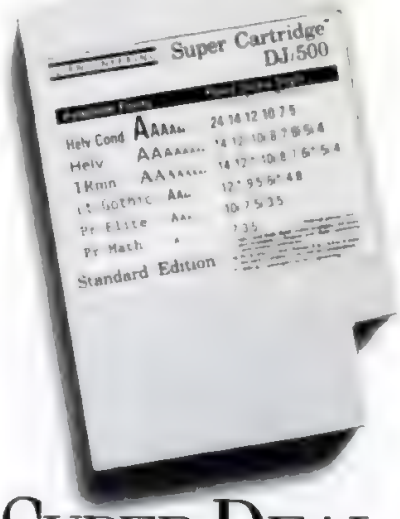

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CIRCLE 325 ON READER SERVICE CARD

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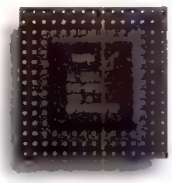

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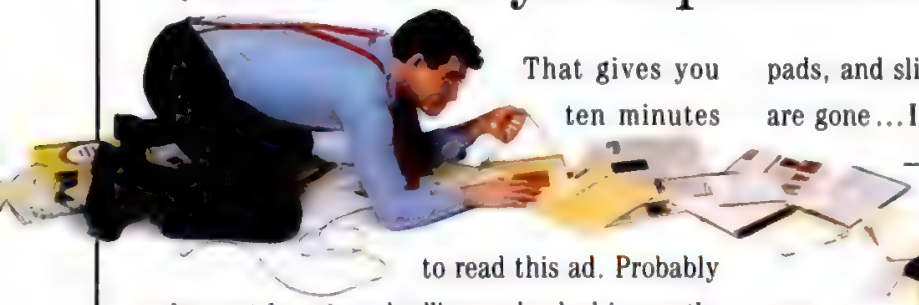

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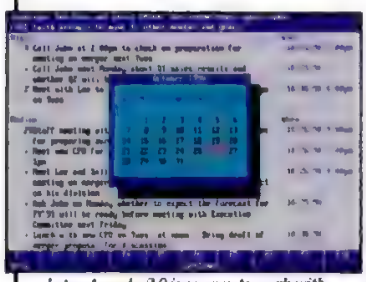

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by
Gus Venditto

Advisor

PRODIGY VERSUS GENIE

Could you please describe both the GEnie and Prodigy systems? Also, what type of equipment is needed to use them?

Spc. Ann Dunar
Ft. Hood, Texas

The two are on-line services that require a PC and a Hayes-compatible modem; both give you access to similar databases and services, but they're radically different in the way the information is presented.

Prodigy requires a graphics adapter (Hercules, CGA, EGA, or VGA) and special software. GEnie can be used with standard communications programs, like *Crosstalk, ProComm,* and many others.

The key difference is that Prodigy is a graphics-based system. When you're connected, Prodigy's information is presented in splashy full-screen images. You run Prodigy with software on your local system that calls the Prodigy host computer and then interprets a stream of instructions sent by the host. The result is a surprisingly animated display that always gives you clear directions.

GEnie operates in the tradition of many private bulletin boards: it's a text-only system and as a result, you need to learn a series of instructions to navigate through the command structure.

Both services let you correspond with other members in private e-mail, though Prodigy does add a surcharge for heavy e-mail use.

Both services provide a wide range of information; there are news, weather, and financial databases. There are shopping services, access to airline schedules, and on-line financial brokers.

The games are probably the most popular part of both systems. On GEnie, most games are question-answer type, but there are some recent innovations that let you download graphics software to your system so you can play on-line and have a colorful display. Of course, Prodigy provides colorful, graphic games.

- PRODIGY VERSUS GENIE: A matter of style?
- CONNECTING ON A BUDGET: Can you create a LAN on only $200 a station?
- MAXIMIZING THE CURSOR IN WORDPERFECT: The simplest way to recover your cursor on a laptop.

Another key difference is that Prodigy is tailored to families; there's a lot of meal-planning advice, children's educational games, and an attempt to screen adult-oriented topics.

GEnie's forums cover a wide range of subjects, and discussions of sexual issues are common.

Finally, Prodigy is unique in that it's supported by advertisers; as a result, you see a sales pitch on nearly every screen.

Prodigy's owners believe its users are happy to see the ads because that means lower connect charges. Prodigy has a flat $12.95 monthly fee with surcharges only for heavy e-mail usage. (Prodigy Services Co.; White Plains, N.Y.; 800-776-3449.)

GEnie has a variety of billing options. There's a special $4.95 monthly service that provides access to a portion of the total system; if you use services beyond these, you pay at the rate of $6 an hour in the evenings (6 P.M. to 8 A.M.) and on weekends, and $12 an hour during weekday hours. (The GEnie Service, Rockville, Md.; 800-638-9636.)

It's probably a good idea to point out here that GEnie bears a great similarity to CompuServe except that CompuServe has a vast number of forums for PC users. These forums are, in effect, public bulletin boards where users share their experiences with hardware and software, sometimes detailing bugs and workarounds. Some of these forums are maintained by the product vendors and often contain new software drivers or patches to fix minor problems. (CompuServe Information Service, Columbus, Ohio; 800-848-8199.)

Perhaps I can best sort out your on-line choices this way: Use Prodigy if you like the idea of a full-featured, easy-to-use service that will entertain as it informs, and if you have children in the house.

Use GEnie if you want access to the databases that are available on all on-line services but want to keep your bills low.

Use CompuServe if you want access to as much on-line information as possible, have a significant investment of time and money in PC products, and are willing to learn how to navigate through an often confusing system.

CONNECTING ON A BUDGET

My budget has an allowance of $200 per system to network ten PCs. Is this at all possible?

Bart Wallace
Cleveland, Texas

I referred this question to the man best qualified to answer, *PC Magazine*'s workgroup systems editor, Frank J. Derfler, Jr. Here's his report:

Your price cap limits both your options and the things you can do with your connected computers.

Networks gain their speed from special interface cards residing in every PC that connect to and share the LAN cabling. But you won't find network interface cards and software available in the price range you define, so you'll have to use the parallel or serial ports existing on your PCs for LAN connections. This will give you a maximum throughput of slightly over 100 kilobits per second, as opposed to throughputs of a megabit a second for modern networks.

You have two options: a zero slot LAN

or a data switch, but neither one gives application programs running on one PC efficient use of files stored on another networked PC.

A zero slot LAN uses software and cables only—there's no intervening hardware. With a network this size, the only practical zero slot LAN product is *LANLink 5X* from The Software Link (Norcross, Ga.; 404-448-5465). But even *LANLink* doesn't come in under your price cap at list price. A two-user starter kit costs $395, and support for additional stations is $100 per user. By shopping wisely, though, you may be able to make the purchases at prices that are close to your budget.

A data switch connects to PCs, as well as to Macs and laptops, through serial or parallel ports. Then the switch, in response to a few characters received down the line, connects any two available serial ports together. Once connected, the laptops, Macintoshes, and other computers can exchange files, share printers and modems, and handle other tasks simply and efficiently. After a task is done, just disable the connection and you're ready for another one. The cost for a data switch is typically $100 per port. The best systems include TSR software, which makes it easy to connect and move your data.

A zero slot LAN uses software and cables only—there's no intervening hardware.

We recommend the data switches available from Buffalo Products (800-345-2356), Digital Products (800-243-2333), Fifth Generation Systems (800-873-4384), Newbridge (703-834-3600), or Rose Electronics (713-933-7673). The switches differ in size, features, and accessory software, so shop around to find the best answer for your laptop connection needs.

For more information, see our review of data switches in the July 1989 issue of *PC Magazine* ("Data Switches: A Low-Cost LAN Alternative").

MAXIMIZING THE CURSOR IN WORDPERFECT

Several issues ago (December 25, 1990), I explained how to increase the size of a cursor so it could be seen on a laptop screen when running *WordPerfect* 5.1.

Michael MacMahon of Kansas City, Missouri, advises that there's no need for one of these enhancers since *WordPerfect* 5.1 has its own cursor control utility. You run it by typing CURSOR at the DOS command line; it lets you change the shape and size of the cursor.

ASK THE ADVISOR

Send your questions to PC Advisor, One Park Avenue, New York, NY 10016 or upload them to PC MagNet (see the instructions for joining on page 8 of this issue). Sorry, but personal replies are not possible. ■

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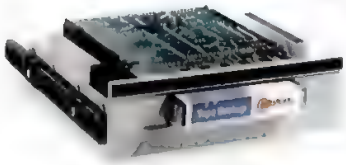

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- Shadow RAM and EMS support for enhanced performance.
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CIRCLE 165 ON READER SERVICE CARD

First Looks

Hands-on Reviews of the Latest Products

Excel 3.0's Toolbar and Outlining: A New Face For Spreadsheets

HANDS ON
By Craig Stinson

Until the release of Version 3.0 in January, Microsoft's *Excel for Windows* had gone more than three years without a significant feature upgrade. As you might expect under those circumstances, the new version represents a huge overhaul. Apart from the database component (which includes one new function but is otherwise unchanged), every aspect of *Excel* has been thoroughly refurbished.

The emphasis has been twofold: to match or improve upon the best ideas of the competition and to beef up the presentation, convenience, and application-development features that have been *Excel*'s traditional strengths.

Like *Lotus 1-2-3/G*, *Excel* 3.0 includes a goal-seeking command and an optimization utility. The optimizer is a version of Frontline Systems' *What-If Solver*, a *1-2-3* add-in. It solves the same kinds of problems as *1-2-3/G*'s Solver, though its reporting capability is less extensive and it doesn't run in the background. (The OS/2 version of *Excel* 3.0, scheduled to ship by midyear, will run in the background.)

Like *1-2-3*, Release 3, *Excel* 3.0 has a workgroup feature to facilitate the setup of parallel worksheets. Once you declare a set of worksheets to be a workgroup, all your data entry, formatting, and printing commands are applied to all members of the group simultaneously.

Like *Wingz*, *Excel* 3.0 offers drawing tools and gorgeous three-dimensional graphs. (It stops short of *Wingz*' polar, contour, and wireframe charts.) Graphs may be displayed alongside worksheet data, greatly simplifying the creation of compound documents, or in separate windows.

The drawing tools can be used for annotating worksheets and charts and for creating automated information systems. Any graphics object on an *Excel* worksheet can become a hot button. Hot buttons can be linked to macros so that a simple click on the object runs the associated macro.

Like Symantec's *Budget Express* add-in for *1-2-3*, Release 2, *Excel* 3.0 does outlining. The program will automatically read the structure of your worksheet

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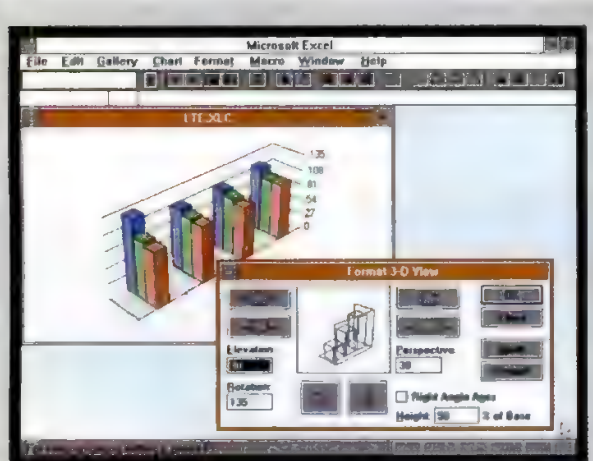

Excel's charting capabilities now include 24 3-D charts that can be rotated to show different perspectives. Notice that the *Word for Windows*-like toolbar across the top of the screen includes a new autosum feature.

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Freelance Goes GUI: OS/2 Version Introduces Smart Approach to Presentations

HANDS ON
By Kellyn S. Beck

Freelance Graphics for OS/2 marks Lotus's entry into the world of GUI-based presentation graphics. It bears little resemblance to its well-known DOS namesake, and the GUI environment greatly extends the presentation metaphor.

The program expands on its traditionally close relationship with *Lotus 1-2-3* (in this case *1-2-3/G*), offers full charting capabilities, good drawing and image manipulation tools, text editing tools that include a spell-checker, and new presentation features. It reads and writes *Freelance* .DRW files but recognizes spreadsheet files only in the .WK3 format.

DOS-based *Freelance* was designed to create images one at a time. Presentation features were tacked on as an afterthought. The OS/2 version treats the presentation as a unit.

At the heart of the package are SmartMasters—a family of presentation templates. Unlike other packages that offer one template or stylesheet to attach to all images in the presentation, *Freelance* SmartMasters come in sets. Each set includes nine variations on a design theme and templates for title slides, bullet lists, and graphics slides. You apply the appropriate template to a page and then plug in your text and graphics data.

SmartMasters use a fill-in-the-blank approach. The assigned Master displays placemarker boxes where text and graphics are entered. The text placemarker provides a text ruler; graphics placemarkers accept charts created in the Graph module, items from the 500-plus clip-art library, or imports from six supported graphics file formats.

CONTINUES ON PAGE 35

Excel 3.0

CONTINUED FROM PAGE 33

and build an outline up to seven levels deep in each dimension (rows and columns). Clicking level buttons then allows you to see just the amount of detail you need. Other benefits include the ability to plot and sum summary cells (omitting the intervening detail cells) and the ability to reorganize worksheets by moving summary levels.

Like *Javelin*, *Excel* 3.0 offers "draggable" chart points. Move a point with the mouse and the program modifies the underlying data cell accordingly. (If the underlying cell is a formula instead of a constant, dragging the chart point invokes the goal-seeking command.)

And like *Quattro Pro*, *Excel* 3.0 allows you to apply conditional colors to cells—red for negative values, for example, or green for numbers exceeding a quota.

Excel's designers have also appropriated some good ideas from in-house. A tool bar now appears above the worksheet, much like the ribbon and ruler of Microsoft's *Word for Windows*. In addition to drawing tools and outlining buttons, the tool bar includes buttons for assigning left, centered, and right alignment, as well as boldface and italic formatting. At the left end of the tool bar is a window via which you can define and apply styles (named combinations of formatting attributes). *Excel*'s styles work just like those in *Word* and offer the same benefits; they ensure consistency within and across applications and give you the freedom to make global formatting changes with a single command.

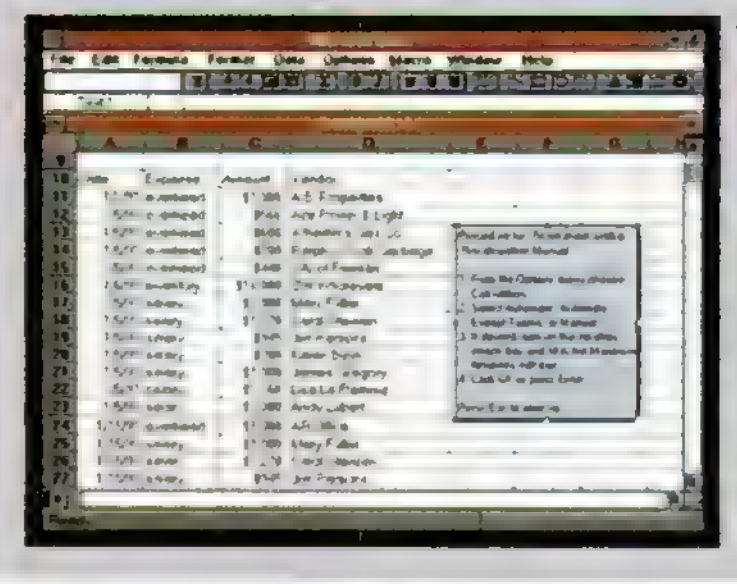
The tool bar also includes an ingeniously marketable item called an autosum button. Click here and *Excel* automatically enters a SUM formula, making its best guess about what cells you want to add. Since summation formulas are usually entered in cells adjacent to their arguments, the button guesses correctly nine times out of ten, saves you typing drudgery, and helps ensure that your formulas are entered accurately.

Many other innovations are less visible but equally important. The Data Consolidate command, introduced with the OS/2 version over a year ago, is now part of the *Windows* product as well, but in a much stronger form. Where the OS/2 Consolidate command rolled subsidiary numbers into consolidated constants, the new version creates either constants or formulas, as you choose. Either way, you can consolidate by position (rolling up the same cells in each supporting worksheet) or by category (rolling up cells by row and column headings, regardless of their addresses). The subsidiary worksheets can be on disk (or server) as well as in memory and can be .WK1 or .WK3 as well as native *Excel* files.

Other worksheet improvements include ten new functions (hyperbolic trig, MEDIAN, SUMPRODUCT, variable-declining-balance, and DAYS-360), elimination of the distinction between simple and complex external references, an expanded Undo command, and an armload of new formatting options. You can now display fractions as fractions (great for stock data), use up to 256 fonts and 16 colors on a worksheet, create multiline labels in single cells, choose from 18 shading and 8 border styles, and automatically adjust column widths and row heights to accommodate widest and deepest entries. Figuring out *Excel*'s numeric formatting language is still a challenge, but the new version helps a little more by showing a sample in the dialog box.

Major enhancements on the charting front (besides the new three-dimensional graph types) include the ability to create picture charts or pictograms, the importing of graphics from the clipboard, a simple dialog box for editing those daunting SERIES formulas, and more ways to customize charts by direct manipulation with the mouse. Among the printing improvements are a more interactive previewer (you can set margins and column widths with the mouse) and the ability to save orientation and scaling settings as part of your worksheet's data.

For *1-2-3* emigres, *Excel* 3.0 offers an interactive help system. If you activate it, you can type any Lotus command and see a demo of the *Excel* equivalent. (Alternatively, the pro-



Typing *1-2-3* commands in *Excel* invokes a help window with step-by-step instruction or an on-screen demonstration of the *Excel* command sequence.

MICROSOFT SAYS OLÉ

No one's quite sure whether to spell it or pronounce it, but the newest buzzword among *Windows* users and developers is OLE. What it stands for—object linking and embedding—is not entirely new. *Windows* users have been linking documents via DDE since *Windows* 2.*x*. And object embedding has been one of the major selling points of HP's *NewWave*. But Microsoft's marketing clout promises to make OLE a commonplace part of *Windows*.

For users, OLE means easier creation of compound documents. When you double-click on an embedded object, it appears in the context of its original application. If your spreadsheet and your word processor both support OLE, you can annotate your worksheets with a text box containing words created in your word processor. To edit the text, you'll double-click the box; the word processor will appear. Quit the word processor, and your worksheet will automatically be updated. The text box, in this case, is the embedded object. Going the other way, you can embed worksheet objects, such as tables or charts, in your word processor's documents.

Excel 3.0 is the second application to support the OLE specification, the first Microsoft's *PowerPoint*. Microsoft will add OLE support to its forthcoming *Windows* apps (including the mini-apps in the *Windows* next revision). Other *Windows* developers will do likewise.

Excel 3.0 users can get a foretaste of OLE's convenience. If you use a formula to link worksheets in the new spreadsheet, you can navigate from the dependent worksheet to the supporting one by double-clicking the external-reference formula. If the supporting worksheet isn't open, *Excel* retrieves it for you.—CS

FACT FILE

***Microsoft Excel* 3.0**
Microsoft Corp., 16011 NE 36th Way, Redmond, WA 98052; 206-936-8080.
List Price: $495 (upgrade from previous versions $129).
Requires: 80286 or later microprocessor, 1MB RAM, *Windows* 3.0 or later. Mouse required for many advanced features.
In Short: A top-to-bottom overhaul, featuring outlining, improved consolidation, stunning 3-D graphs, many new formatting options, and improved support for *Lotus 1-2-3* converts.

CIRCLE 714 ON READER SERVICE CARD

Excel 3.0

CONTINUED FROM PAGE 34

gram will plant a verbal description on your worksheet in the form of a movable text box.) For application developers, the upgrade offers the ability to save macros (optionally incorporating DLLs) in an add-in format. Such macros, when invoked, simply augment the native command set.

On top of everything else, the thing runs faster. PC Magazine Labs' gruesome number-crunching test, worksheets recalculate on average 27 percent more quickly in *Excel* 3.0 than in *Excel* 2.1.

With this upgrade, Microsoft has regained the right to claim the most advanced and easiest-to-use spreadsheet. Now the ball is back in Lotus's and Borland's court. ■

EXCEL: Looking for a Third Party

Microsoft has never wooed third-party add-ins the way Lotus has, but there are now opportunities for innovation. *Excel*'s DDE links, graphics, and "hot buttons" make it a ripe environment. At January 9th's launch, *Excel*'s ISV pioneers displayed their wares.

On the data retrieval front, Channel Computing's *Forest & Trees for Windows*, a program that collects, analyzes, and monitors data from disparate sources, showed support for *Excel* 3.0. Micro Modeling Associates announced *Cicero* for data retrieval and analysis from financial databases. And Reuters unveiled an *Excel* 3.0 version of their *Excel Access* providing real-time financial information directly into the spreadsheet.

On the connectivity front, Saros Corp. and Glibert & Associates announced *VIEWz* 1.2, a spreadsheet library manager based on the Saros *Mezzanine* network application platform that lets users manage spreadsheets across the network from within *Excel*. DCA demonstrated its $495 *IRMA WorkStation for Windows*, a micro-to-mainframe communications program with *Excel* 3.0 support. A demonstration showed how *IRMA*'s QuickScript language could be used with DDE to allow *Excel* users mainframe access.

Similarly, Wall Data's $495 *RUMBA* 3.1 uses DDE links to place information from 3270 mainframe applications in *Excel*'s spreadsheet. Wonderware announced four new connectivity products that extend DDE capabilities to factory controllers, serial ports, and other I/O.

And there are other far-flung offerings. Palisade Corp. showed its *Excel* 3.0–compatible version of *@RISK*, a $395 risk analysis and modeling program first introduced as a *Lotus 1-2-3* add-in. In the value-added category, Frontline Systems, the developers of *Excel*'s Solver module, launched a fax- and BBS-based information service to help advanced Solver users. And, just in time for April's deadlines, Heizer Software's line of tax software is now fully compatible with *Excel* 3.0. Finally, the shape of things to come was most clearly demonstrated by PromisedLand Technologies' *Braincel*, a $249 neural network software package run from within *Excel* 3.0.

—**Robin Raskin**

Freelance

CONTINUED FROM PAGE 33

Since SmartMasters do the design work for you, you can concentrate on content. This can be constraining since they are designed for aesthetic value and not utility. You can detach or modify them on a per image basis, but you run the risk of wrecking your design integrity.

Other presentation features include on-screen thumbnails for viewing and reordering images. *Freelance* can print groups of thumbnail-sized slides on a page as handouts, but it lacks a built-in outliner.

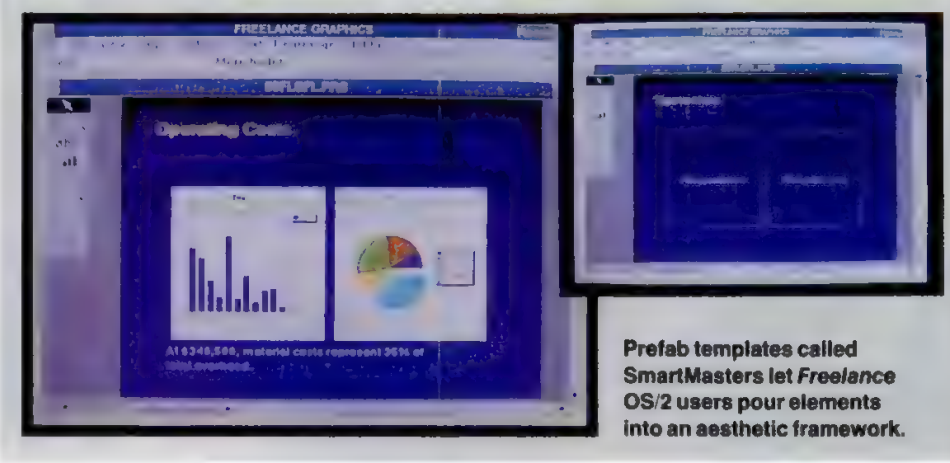
Text editing, drawing, and charting features are robust. There are five text styles and a text rotation feature. *Freelance* has no fonts of its own but supports all the PM typefaces. While these were limited with OS/2 1.2, 1.3's inclusion of italics expands the possibilities.

The graphics toolbox has eight drawing tools including one for creating Bezier curves. Each tool has underlying attributes: edge color and width, fill colors and patterns. Image editing tools move, magnify, create groups, assign foreground priority, and more. The color libraries contain 120 colors; palettes drawn from them have 18 colors apiece.

Freelance has tight links to *1-2-3/G*. When both products are installed they share a graphing module capable of creating the five basic graph types, including perspective 3-D bars and hi-lo-close graphs. But running these two programs together creates a lag. *Freelance* alone ran slowly on a Compaq 386/25 with 4MB of RAM; the addition of *1-2-3/G* bogged performance down considerably. Lotus suggests that running both programs together requires 5MB of RAM.

Freelance supports output to any device supported by Presentation Manager. Again, Version 1.3 of OS/2 adds to the printer driver support, but there is no support for film recorders. Lotus plans to announce a slide service link with Autographix by the time we go to press.

Freelance is not the most compelling reason to move to OS/2, but OS/2 devotees will find life more presentable because of it. ■



Prefab templates called SmartMasters let *Freelance* OS/2 users pour elements into an aesthetic framework.

FACT FILE

Lotus Freelance Graphics for OS/2
Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; 617-577-8500.
List Price. $400; upgrade from *Freelance Plus*, $150.
Requires: 4MB RAM, OS/2 1.2 or later.
In Short: *Freelance*'s SmartMaster approach lets you create quick, attractive presentations under OS/2.

CIRCLE 704 ON READER SERVICE CARD

Managing Your Money Improves its Looks

HANDS ON
by Christopher Barr

After a much-needed facelift, Meca Software's *Managing Your Money* has entered the GUI Age. Thanks to its slick CUA-like user interface, Version 7.0 is not only faster but also easier to use. A main menu bar speeds both navigation and command selection, and basic keystrokes are—at long last—consistent with the rest of the civilized software world. You no longer have to remember, for instance, that Esc calls up help. A tap of the F1 key now does the trick, just as it does in most other properly designed programs.

Managing Your Money 7.0 *(MYM)* may look different from previous versions, but it provides the same essential tools that made *MYM* the perennial leader in its class. The core of the program, an accounts module, keeps track of your income and outgo. Here you can set up budgets, do your cash flow forecasting, and generate reports—complete with graphs.

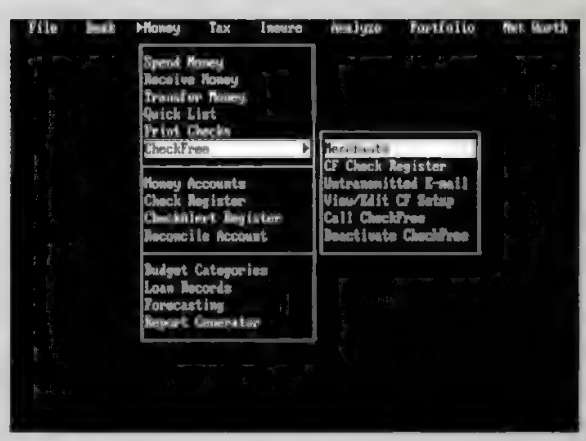
MYM's check-writing and printing facility, although adequate, doesn't match the speed and simplicity of Intuit's *Quicken*. Like *Quicken*, *Managing Your Money* has a link to *CheckFree* that allows you to pay your bills electronically.

MYM clearly outdoes *Quicken*, however, when it comes to investment portfolio management. *Managing Your Money* is for the investor who wants to track any type or number of assets, including stocks, cash, bonds, IRAs, stamps, coins, butterflies—you name it.

Managing Your Money can also help you plan your tax strategy. The software includes the text of the tax code for 1990 and 1991, and Meca has added a direct export link to their *TaxCut* tax return preparation software.

Beyond these fundamental capabilities, *MYM* has features that help you with a wide range of financial tasks. One module even preps you for sales calls from life insurance salesmen. An asset analyzer section lets you work up what-if investment scenarios. Retirement and tuition-planning tools remind you of just how expensive life can be. Touches of wisdom and humor from Andrew Tobias temper all of this normally tedious planning and record keeping.

For even more efficiency, *MYM* adds a desktop organizer complete with a reminder pad, appointment book, auto-dialer, word processor, and calculator. However, you'll need close to 2.5MB of disk space to accommodate these features.



The distinguished personal money manager has a new user interface that makes it faster and much easier to use.

If you simply need a check-writing program, you can't beat *Quicken* for speed and ease of use. But if you want to take control of your financial destiny, then step up to *Managing Your Money*. ■

List Price: *Managing Your Money*, Version 7.0, $219.98. **Requires:** 512K RAM, DOS 2.*x* or later. Meca Software Inc., 327-D Riverside Ave., Westport, CT 06880; 203-222-9150.

CIRCLE 712 ON READER SERVICE CARD

386MAX Makes Peace With Windows

HANDS ON
by Dave Methvin

Since the advent of *Windows* 3.0, *386MAX* users have faced a depressing either-or proposition: run *386MAX* and free up lots of low DOS memory or run *Windows* 3.0 in enhanced mode and live with cramped DOS sessions. The only way to change between the two was to reboot.

With Version 5.1, Qualitas eliminates the either-or dilemma. Like Quarterdeck's *QEMM*, *386MAX* 5.1 now can load device drivers and TSRs into high memory before a *Windows* session begins. As a result, DOS sessions started from within *Windows* can use considerably more low DOS memory.

Like the earlier version, 5.1 offers simple installation. An option called MAXimize finds the best fit among device drivers and TSRs to make the most out of high memory.

For *Windows* users, the hottest feature in *386MAX* is *instancing*, which gives you a copy of a relevant driver or TSR in each of the multiple DOS sessions. Think of ANSI.SYS, which stores the current screen colors inside the memory where it is loaded. If you start two separate DOS sessions from within *Windows*, you'll find that the color last selected in any DOS session applies to all DOS sessions. The problem isn't limited to ANSI.SYS. It affects any program where some of the internal data might be different in each DOS session.

This problem exists regardless of whether a program is loaded into low or high memory. The *Microsoft Windows* documentation suggests that you start a DOS session and then load any TSRs. But this won't work for device drivers like ANSI.SYS, and it creates a Catch-22 condition for those who need a large DOS session. The catch: Programs can be loaded in high memory only before *Windows* is started, yet *Windows* will run them correctly only if they are loaded after *Windows* is started.

Instancing remedies many of these problems, and you don't have to understand it to utilize it. Qualitas has created a list of software that needs to be instanced, and *386MAX* automatically instances software that it finds on the list. Qualitas' technical support can provide help for instancing applications not included on the list.

386MAX also supports ROM shadowing under *Windows*. At boot time it copies ROM-based code such as the VGA BIOS to RAM so that it will execute faster. *386MAX* also makes safety checks at boot time to guard against known problems with certain disk caches and SCSI disk controllers.

There are still things that *QEMM* can do that *386MAX* cannot, like move DOS file buffers into high memory and run in *Windows* standard mode. With third-party disk cache software and *Windows* enhanced mode, you probably won't mind.

Qualitas has also updated its PS/2-specific product to support *Windows*. *BlueMAX* gives users of PS/2 Micro Channel systems more high DOS memory by remapping unused BIOS ROM areas and reconfiguring add-in boards. ■

List Price: *386MAX*, Version 5.1, $130. **Requires:** DOS 3.0 or later. Qualitas Inc., 7101 Wisconsin Ave., #1386, Bethesda, MD 20814; 301-907-6700.

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- ☐ Penwin
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Stacker Coprocessor Offers Real-Time File Compression/ Decompression Without Sacrificing DOS Compatibility

[redacted]

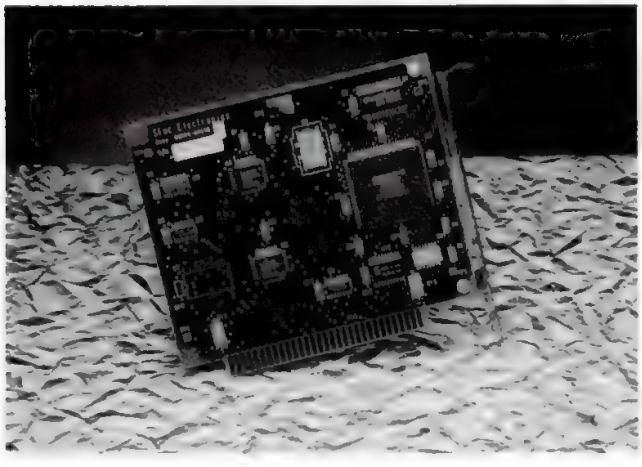
Stac Electronics' Stacker Coprocessor is a $229 file compression board that automatically compacts and decompresses files as you work. The board and software combo allows you to increase the capacity of your hard disk by compressing the files already present on the disk, and by compressing any new ones you add, in real time.

And unlike the early version of InfoChip System's Expanz! compression board that wouldn't let you use some defragmenting and unerase utilities (First Looks, November 13, 1990), you can continue to use your favorite disk utilities including *The Norton Utilities* and *PC Tools*. (Some early problems we reported with the Expanz! board have since been rectified; InfoChip now offers a proprietary defragmenter and an unerase routine but is still not compatible.)

Stacker gives you real-time lossless compression. Unlike software utilities such as *PKZIP* or *LHARC* that require you to run the program each time you need to compress or decompress a file, Stacker's real-time compression is handled by its onboard coprocessor. Files are compressed and stored on the hard disk, and the process is so fast that you'll never know it's happening. Lossless compression means that none of the data are deleted or changed in the compacting procedure.

The Stacker half-card plugs into a PC's 8-bit slot. No Micro Channel version of the board is available, but there is a software-only version that can be used in MCA machines and laptops. Stacker operates under versions 3.*x* and 4.*x* of DOS and is automatically loaded as a driver in your CONFIG.SYS. Stacker's automatic install sequence creates a hidden file on your hard disk, which appears as an additional drive letter.

Any files written or copied to the Stacker drive are compressed automatically. Files written to other logical drives remain uncompressed. We also tested Stacker with DR DOS 5.0, and though we encountered problems with the automatic installation, after installing it manually, it worked well.



Stacker Coprocessor provides lossless data compression reclaiming as much as half of your hard disk space.

FACT FILE

Stacker Coprocessor
Stac Electronics, 5993 Avenida Encinas, Carlsbad, CA 92008; 800-522-7822, 619-431-7474.
List Price: $229; software only, $129.
Requires: Any non-MCA expansion slot; 512K RAM; 1MB free hard disk space; DOS 3.*x* or later.
In Short: A real-time compression/decompression board that increases the capacity of your hard disk by compacting stored data.

CIRCLE 431 ON READER SERVICE CARD

PC Magazine Labs tested the Stacker Coprocessor on an IBM PC AT with a 30MB hard disk. Stacker is compatible with all types of Winchester hard disks including ESDI, SCSI, and IDE. RAM disks, floppy disks, Bernoulli boxes, WORM drives, and CD-ROM drives are not supported, although Stac pledges future versions will work on floppy disk drives and RAM disks.

The amount of compression achieved depends on the type of file you are compressing. Stac claims that on average, most users will reclaim half of their hard disk with a 2:1 compression ratio. Our tests showed an average of 1.8:1, with the greatest compressions—up to 8:1 with some graphics files. Most text files were packed 2:1, while most .EXE files were reduced by 1.5:1. Spreadsheet and database files averaged a 2.5:1 compression. Files that had been already archived with *PKZIP* or *LHARC* showed no change.

Of course, the penalty you pay for this increased storage space is reduced RAM. The device driver devours 30K of RAM and the coprocessor demands 16K as a high memory window. To recover RAM, Stacker's device driver can be loaded into high memory, and is compatible with *QRAM*, *Move'em*, *QEMM-386*, and *386MAX*.

You won't be penalized with slower disk access, though. When you install Stacker it optimizes your hard disk, and adds a small cache through the driver. With the board installed, our benchmarks averaged a 15 percent increase in most DOS file access tests. To increase disk access speed further you can still use Multisoft's *Super PC-Kwik* or *PC Tools*' PC-Cache without any conflicts.

Stacker includes software utilities that replace the DOS commands in order to show you the compression ratio of the files. There are replacements for DOS's DIR, and CHKDSK commands that will show the compression ratio of a file and disk respectively, but you're not required to use these in order to take advantage of the compression features. All of DOS's utilities, including CHKDSK and DIR, are fully compatible.

If you boot your machine from a standard DOS disk, the files on the compressed volume won't be available because they're in a hidden file on the host drive. You'll always want to boot with the coprocessor/software combination.

However, your data is safeguarded against hardware malfunctions. If the board is pulled from your computer or becomes unusable for any other reason, your compressed files are still accessible through the software driver. The software alone is capable of decompressing and compressing files, although at a slower rate than when aided by the coprocessor.

Stacker doesn't prohibit you from using all your favorite disk repair utilities including *The Norton Utilities*' Disk Doctor and *PC Tools*' Diskfix. Stac doesn't recommend using a defragmenter on the compressed volumes, because it could cause the disk to fragment, but suggests using defragmenters on the host drive instead.

Stac Electronics has been providing compression products to the computer industry for years. You'll find their software algorithms in *PC Tools* and in compression controllers in QIC tape drives and DAT drives. Stacker is the company's first end-user product. It's an easy way to provide lossless data compression, considerably less expensive than buying a new hard disk, and a no-brainer to use and install. ■

1-2-3 works with either DOS or Windows 3.0. You don't have to change the way you work to work with Release 3.1

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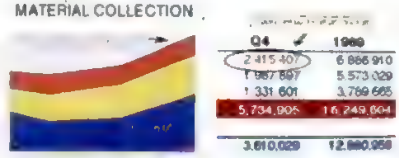

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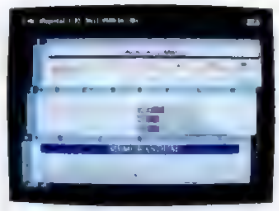
Enter data with a keyboard; manipulate it with a mouse. Release 3.1 lets you work with either, or both.



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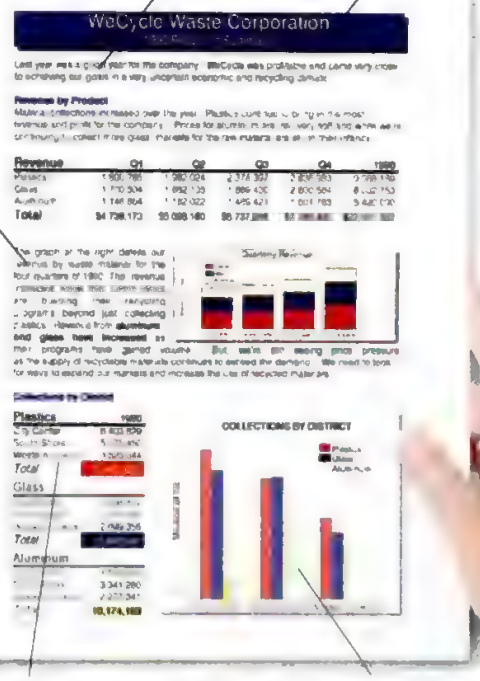

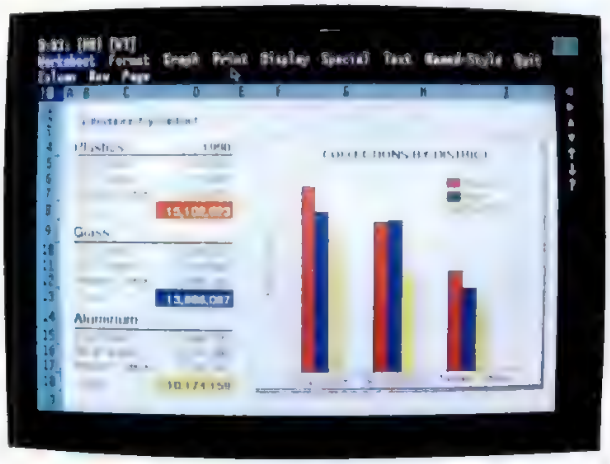

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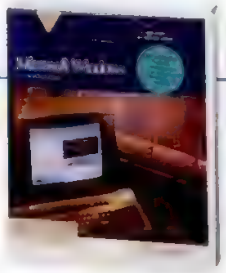

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CIRCLE 138 ON READER SERVICE CARD

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MainLan: Low Priced Ethernet Starter Pack

HANDS ON
By Kimberly Maxwell

US Sage, a company formerly known for its DOS-based LAN that used a proprietary cabling scheme, has entered the mainstream. Its new Ethernet-based peer-to-peer network operating system is designed for small- to medium-sized businesses. The new *MainLan* allows network users to share programs and files, use network devices like printers and plotters, and send and receive messages using network adapter cards that adhere to IEEE 802.3 specifications. But the best feature of *MainLan* is its low cost—$499 for a two-station Ethernet Starter Pack.

You can purchase *MainLan* Ethernet adapter cards for ISA and MCA bus PCs or for IBM PS/1s. The PS/1-compatible product is primarily targeted for markets outside the U.S., where the PS/1 is more widely accepted as a business computer. Like Compex's *ReadyLINK*, (reviewed First Looks, February 26, 1991) Ethernet adapters sold by US Sage come bundled with drivers for Novell's *NetWare*. If your organization outgrows the *MainLan* software, you can reuse the *MainLan* hardware under *NetWare*.

MainLan's Ethernet Starter Pack includes two 8-bit Ethernet cards, cabling, connectors, network operating system software, and network drivers. You pay only $199 for additional adapter cards. The 8-bit card is smaller than typical LAN adapters because US Sage uses surface-mount technology and a proprietary, highly integrated Ethernet processor and chip set.

A simple one-minute installation plus easy-to-configure server and workstations are two good reasons to buy this product—particularly in situations where ease of use is paramount. The package includes clearly referenced documentation and a helpful tutorial designed to prepare *MainLan* uses for real-world network situations.

MainLan requires up to 55K of RAM on a PC providing full server capabilities, but you can adjust the RAM usage depending on the individual station or server requirements. You have the option to load several TSR modules into expanded memory with the software's built-in memory manager, and you can omit modules you don't need to use during the installation. The Menu Handler, Printer Diverter, and Disk Sharer TSRs can all be moved into expanded memory, bringing the RAM requirements down to as little as 16K per station. Without expanded memory you should count on using 32K RAM in a PC acting as a network client.

To enter *MainLan*'s menu system from a workstation you can either use a simple hotkey combination or type NETMENU. The menus include options to retrieve files from another networked computer's hard disk or to send files to a remote machine. They also allow you to erase or rename files on a remote machine. Those who prefer using the DOS command line can do so using rather simple commands. *MainLan* can also run under *Microsoft Windows* in real, standard, or enhanced modes.

Disk sharing allows users to share disk resources on their own computer with other workstations on the network. It also allows workstations to access disks on other computers. Both capabilities let users share programs, transfer files, and access common data. User access to shared disks can be limited with simple password protection; you can also protect directories by granting read, write, or create capabilities for other network users with the NETSETUP utility.

The print utilities are similar to those found in other operating systems. You can divert all printed materials to a named network printer, view all of the printing tasks in the queue, and cancel any queued print jobs as necessary. A LOCALPRN utility improves performance of networked printers attached to the server by determining the best printer transfer speed. It also gives you the opportunity to alter print jobs, giving certain jobs priority.

MainLan's mail option lets users store mail on their own computer, or create a mail server where all mail on the network resides in a common directory. If you use a station as a central mail server, each person is notified of mail sent and given a password for retrieval.

MainLan has no disk cache utility; its performance suffers. Other networks like *LANtastic* and *ReadyLINK* include disk cache utilities. (*LANtastic*'s utility requires configuration upon installation; *ReadyLINK*'s is automatically loaded with preset conditions.)

We first tested *MainLan* and *LANtastic* without any disk cache. Next we used a third-party disk cache utility, HyperWare's *HyperDisk*, on both systems. *LANtastic* ran three times faster than *MainLan* with the disk cache utility installed. Without the cache there was less of a discrepancy, but *MainLan* was still slow, almost 2.5 times slower than *LANtastic*.

US Sage's effort to enter the standardized Ethernet-based DOS-LAN market is a good one. However, neither easy installation nor simple operation mitigates the lack of a disk cache. US Sage needs to concentrate on improving *MainLan*'s performance. ■

FACT FILE

MainLan
US Sage Inc., 2005 Tree Fork Ln., #113, Longwood, FL 32750; 800-999-6770, 407-331-4400.
List Price: $499 for Ethernet Starter Pack. (Includes two Ethernet cards, cabling, network operating system software, and network drivers.)
Requires: 640K RAM, DOS 3.1 or later.
In Short: *MainLan* marks US Sage's entry into the standardized Ethernet DOS-LAN market. While the product is solid and the price is right, the performance could be improved.

CIRCLE 700 ON READER SERVICE CARD

BENCHMARK TESTS: MAINLAN

LANtastic ran three times faster than *MainLan* with the disk cache utility installed. Without the cache there was less of a discrepancy, but *MainLan* was still slow, more than twice as slow as *LANtastic*.

The **Hard Disk Access Load** test heavily loads the hard disk and disk caching system. Each load station randomly accesses its own 100K data file using 1K records while the timed station transfers files. This procedure tests how well the software handles the drive and the speed of the disk subsystem. Because *LANtastic* includes a built-in cache and *MainLan* does not, we ran the test three times: with cache disabled, with *LANtastic*'s built-in cache enabled, and with a third-party cache, *HyperDisk*.

(Throughput in megabits per second)	Hard Disk Access Load No Load Station	One Load Station
NO CACHE		
LANtastic	1.22	1.20
MainLan	0.57	0.50
WITH HYPERDISK CACHE UTILITY		
LANtastic	2.06	1.83
MainLan	0.70	0.59
WITH BUILT-IN CACHE		
LANtastic	2.67	2.37
MainLan	N/A	N/A

N/A—Not applicable. This product does not include a built-in cache.

Protolyzer: Network Analysis for Modern Times, At Modern Prices

HANDS ON
by M. Keith Thompson

ProTools' *Protolyzer* rises above the traditional protocol analyzer genre. It's a network analyzer cum management tool. Unlike the *Sniffer* (LAN Analyzers, June 26, 1990), *Protolyzer* concentrates primarily on filtering and analyzing the network data, rather than on protocol analysis.

Also unlike the *Sniffer*, *Protolyzer* is a software-only solution—which for most companies provides a more cost-effective solution—even though you need to install the software on a 386- or 486-based computer with 8MB of RAM running OS/2.

In most cases, installing *Protolyzer* on a stationary computer works fine. If, however, your LAN includes multiple segments, it's better to install *Protolyzer* on a portable computer allowing you to monitor all segments. *Protolyzer* works on Ethernet, as well as both 4- and 16-Mbps (megabit-per-second) Token-Ring topologies.

FACT FILE

Protolyzer
ProTools Inc., 14976 NW Greenbrier Pkwy., Beaverton, OR 97006-5733; 503-645-5400
List Price: $14,995; unbundled version, $8,995; $995 per protocol.
Requires: 25-MHz 386 or faster, 8MB RAM, 100MB hard drive, OS/2 1.2x; Ethernet NE2000 or NE/2, Token-Ring Proteon p1347 or p1840.
In Short: A thoughtfully designed, OS/2-based, software-only newcomer to the network analyzer arena. Better suited for network analysis than hard-core protocol analysis.

CIRCLE 449 ON READER SERVICE CARD

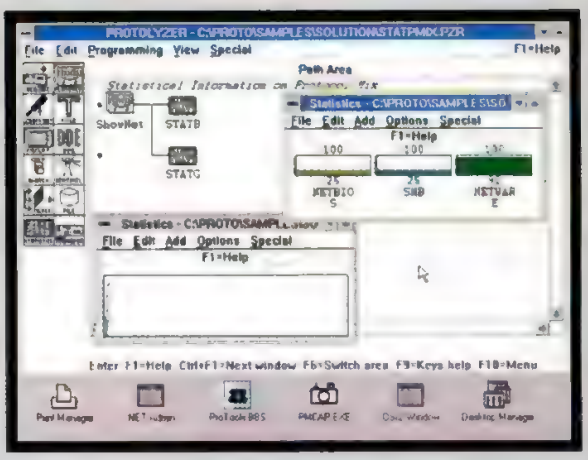
The software has a modern feel to it: It's flashy and functional at the same time. The OS/2-based graphical environment plus the object-oriented/icon-driven functions create a pleasant workspace.

As a protocol analyzer, *Protolyzer* doesn't measure up to *Sniffer*; it does not support as many protocols. However, *Protolyzer* is easier to use and, through DDE links with specialized applications like *Lotus 1-2-3/G*, it can display and manipulate network data in a more useful fashion. Currently, *Protolyzer* only decodes Token-Ring, Ethernet, *NetWare*, NetBIOS, and SMB protocols. As they become available, additional protocols can be downloaded from ProTools' BBS; they will also be mailed free to all registered users.

Protolyzer's greatest strength is in displaying information. It maintains records of normal network activity which can be stored in data files and displayed by *Protolyzer* or *Lotus 1-2-3/G*. Being able to compare a snapshot of a healthy network against a problem network helps when isolating network problems.

Protolyzer allows countless manipulations of the data it gathers from packets or frames on the network. For instance, you can ask it to capture all of the frames originating from "Bill's" computer that are destined for node address 02608C1BB554 after "Sam" logs off the network. Or you can filter the source address for all frames going to the printer in order to charge back departments on a usage basis.

The object-oriented interface makes designing network monitoring criteria easy. Each of the 12 icons on the main design screen represents a step in the analysis process. You drag the icons into a path area on the screen in the order you want the actions to occur. *Protolyzer* is smart enough to prohibit you from entering icons in an illogical order. A typical game plan would be to use the ACQUIRE icon to gather network information, SORT the packets on the source address, and then DISPLAY them in a window.



***Protolyzer*, an OS/2-based network analysis tool, can play back captured frames (packets) and show a graphical representation of protocols on the network. The line graph shows the mix of protocols over time; the bar chart displays the number of frames for each protocol.**

Protolyzer includes a full list of competitive features. In addition to the standard features of high-level protocol decoding and network traffic statistics, *Protolyzer* includes graphical representation of data, alarms, data playback, and a useful collection of display tools. It offers tremendous flexibility for filter and triggering options—which helps to limit the amount of information you'll have to sift through to solve a problem.

Another *Protolyzer* strong point is its multitasking capability. The program can be set to monitor network traffic; simultaneously you can arrange for a message to be sent to a user or group of users when a predetermined event occurs. You can also play back data onto the network as you capture current network activity.

Protolyzer includes the decoding features necessary to provide a thorough look at the problem packets. Error messages are reported in the standard GUI format, in a window with buttons for "OK" and "HELP."

Certain elements of the program could be improved. The installation routine exits ungracefully if you try to select an IRQ other than those listed—and the list stops at IRQ 5. Also, *Protolyzer* unnecessarily binds itself to the network card in your system and cannot work on any other adapter on the network. This makes it difficult to move your analyzer around the network without using a portable computer. Another annoying idiosyncrasy is that you are required to manually accept the licensing agreement each time the program loads.

Finally, *Protolyzer*'s network adapter support could also be improved. In the Ethernet arena, *Protolyzer* only supports the NE2000; on Token-Ring networks it runs only on Proteon cards.

The $14,995 purchase price buys considerable support: one year of technical support, access to the ProTools BBS, and free program updates and protocols.

While we'd like to see some immediate improvements in the areas of installation and network adapter support, you'll find that *Protolyzer* is easy to use, presents data in a variety of views, and takes advantage of OS/2's multitasking and multithread functions. ■

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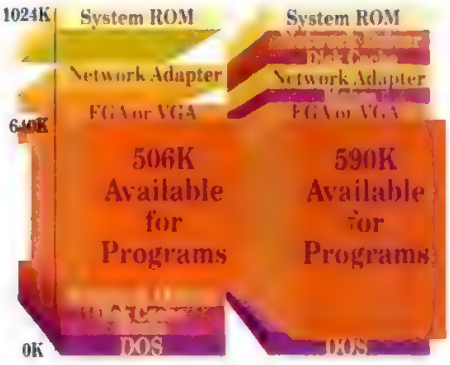

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DESQview System Requirements: IBM Personal Computer and 100% compatibles (with 8086, 8088, 80286, 80386 or i486 processors) with monochrome or color display; IBM Personal System/2 • Memory: 640K recommended; for DESQview itself: 0-155K • Expanded Memory (Optional): expanded memory boards compatible with the Intel AboveBoard; enhanced expanded memory boards compatible with the AST RAMpage; EMS 4.0 expanded memory boards • Disk: two diskette drives or one diskette drive and a hard disk • Graphics Card (Optional): Hercules, IBM Color/Graphics (CGA), IBM Enhanced Graphics (EGA), IBM PS/2 Advanced Graphics (VGA) • Mouse (Optional): Mouse Systems, Microsoft and compatibles • Modem for Auto-Dialer (Optional): Hayes or compatible • Operating System: PC-DOS 2.0-4.0, MS-DOS 2.0-4.0 • Software: Most PC-DOS and MS-DOS programs; programs specific to Microsoft Windows 1.03-3.0, GEM 1.1-3.0, IBM TopView 1.1 • Media: DESQview is available on either 5-1/4" or 3-1/2" floppy diskette.

Trademarks: Windows, MS-DOS: Microsoft Corporation; PS/2, Interleaf, TopView: IBM Corporation; 80386, i486, AboveBoard: Intel Corporation; 1-2-3: Lotus Development Corporation; AutoCAD 386: Autodesk, Inc; RAMpage: AST Research; Hercules; Mouse Systems; Hayes; GEM, Digital Research, Inc.

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CIRCLE 338 ON READER SERVICE CARD

Hayes's SmartCom Exec: Adds Networking, Preserves Low Cost

HANDS ON
by Nick Ayre

The competition among communications programs may seem more like a skirmish than a war to those who follow software struggles, but it's a battle where the users ultimately come out as winners. Hayes has fired the most recent salvo with the release of *SmartCom Exec*, Version 2.0.

Exec adds network support to a program that was already very sophisticated, yet easy to use. And there's no increase in *SmartCom Exec*'s list price of $129. Free upgrades are available to registered owners of Version 1.0.

To truly support networking, a communications program must support the API of the communications server. Higher-end packages such as *SmartCom III* and *Xtalk Mk4* both support networking, but *Exec* is one of the few "easy-to-use" packages with this support. With Version 2.0, both standalone and networked personal computers have access to a list of features that include: TTY, VT 102, and ANSI.SYS terminal emulation, support for Xmodem, Ymodem, Zmodem, and Kermit file-transfer protocols, keyboard macros, and a powerful script language.

Because the new version supports the NCSI/NASI interface and variations of the INT 14 interface, *Exec* is now compatible with communications servers like Novell's NACS, Network Products' ACS^2 and NMP, J&L's NCS, and 3Com's Communications Server. The package allows modem sharing and, through a BIOS printing option, printer sharing.

The package ships on three 5.25-inch disks or two 3.5-inch disks, and includes three small manuals: a general user guide, a SCOPE Technical Reference, and, new to Version 2.0, a network user guide. The new 24-page network guide has clear directions for installing *Exec* either on individual PCs, or on a file server, as well as API-specific notes on making the network connection, and some tips for administrators. The manuals are not rich in technical detail, but they are well organized and have most of the necessary information.

The phone book metaphor, which has become a standard for communications programs, is part of *Exec*. (The phone book combines the Activity and Connection settings found in *SmartCom III*, Hayes's higher-end communications software product.) The user interface consists of menus, tables, settings screens, and dialog boxes, which can all be manipulated from the keyboard and/or with a mouse. Extensive, context-sensitive help is available.

Though *Exec* is easy to use, it's far from unsophisticated. *Exec* is one of a handful of programs, including *Crosstalk Communicator*, *Qmodem*, and *Telix*, that take full advantage of the newest buffered 16550A UART from National Semiconductor. The software will automatically detect and take advantage of a UART which may be found on a system board, in an internal modem, or in a product such as Hayes ESP Enhanced Serial Port (reviewed in First Looks, December 25, 1990). If a 16550A is detected, a 16-byte FIFO buffer is activated to insure no data is lost during high-speed data transmission.

Exec will also support IRQ sharing when the system permits. (At present, only PS/2s with an MCA bus take advantage of IRQ sharing.) The program is the first to fully support the Hayes Enhanced Serial Interface as implemented in the Hayes Enhanced Serial Port. This enables high-speed (above 9,600 bps) data transmission, without losing data, even on slow machines, or in multitasking environments.

In addition, *Exec* features a fully integrated text editor, and a powerful peruse buffer that can hold an ASCII capture of everything that scrolls by your screen during a communications session. You can enter the peruse buffer at any time during a session, edit the contents, print or write a portion or all of the contents, and even do string searches on the contents. Finally, you can easily create keyboard macros; *Exec* will even allow you to assign a script to run as a macro.

Exec ships with Hayes' Simple Communications Programming Environment (SCOPE), a powerful scripting language that includes all of the script statements you need to customize the environment, manipulate the user interface, and control remote and local file operations. SCOPE is borrowed and abbreviated from *SmartCom III;* the *Exec* version only eliminates a few statements. SCOPE scripts written in *Exec* can be used in *SmartCom III; SmartCom III* scripts can be translated and then used in *Exec*. There are five enhanced *Exec* script statements that take advantage of networking features new to Version 2.0.

The program's unique "trigger" statement allows event-driven programming, although traditional "wait for" statements that anticipate actions are also included in the language. Most popular script dialects have no "trigger" equivalent.

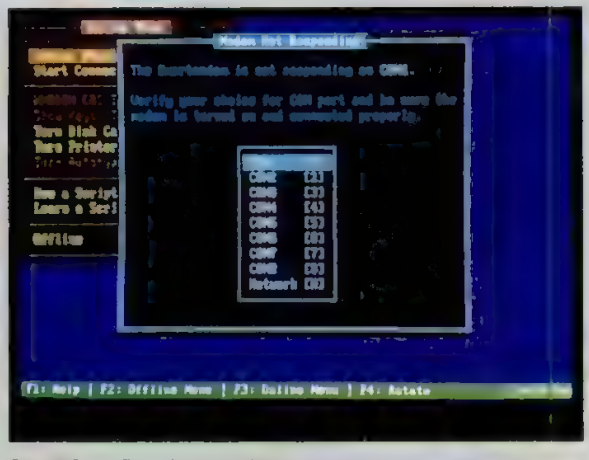
Exec has two major shortcomings, and both can be fixed with a simple phone call. First, the program does not ship with CompuServe B file-transfer support. Second, it doesn't include friendly sample scripts to automate access to popular electronic services, like CompuServe and GEnie. Fortunately, these scripts can be easily downloaded from the Hayes Online BBS (800-US-HAYES if you are a registered user). Customer support is also available on the BBS, as well as on CompuServe, or by phone.

While *Exec* is designed to be palatable to beginners, its rich feature set make it an attractive program for intermediate *and* advanced users, too. Its support for networking and the 16550A UART give it a technological edge over other easy-to-use communications programs. ■

FACT FILE

***SmartCom Exec*, Version 2.0**
Hayes Microcomputer Products Inc., P.O. Box 105203, Atlanta, GA 30348; 404-449-8791.
List Price: $129.
Requires: 512K RAM, hard disk, DOS 2.0 or later.
In Short: A sophisticated and extremely easy-to-use, reasonably priced communications program that now offers network support.

CIRCLE 706 ON READER SERVICE CARD



***SmartCom Exec* is one of few mid-level communications packages to offer network support.**

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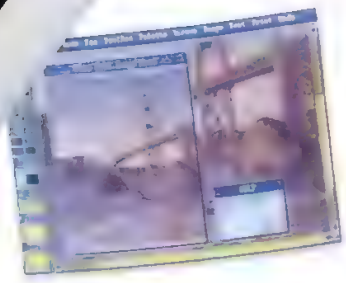

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CIRCLE 492 ON READER SERVICE CARD

OmniPage OCR Goes Pro, Adds 32-Bit Capabilities

HANDS ON
by Lori Grunin

Caere Corp.'s upgrade of its *OmniPage/386* OCR software has a split personality. Instead of releasing one feature-packed product to run in the *Windows* 3.0 environment, the company has issued two separate packages that share a core recognition engine. The $695 *OmniPage* 3.0 is a relatively tame update of the previous version, but the $995 *OmniPage Professional* incorporates several important features that clearly establish it as the new standard in character recognition software.

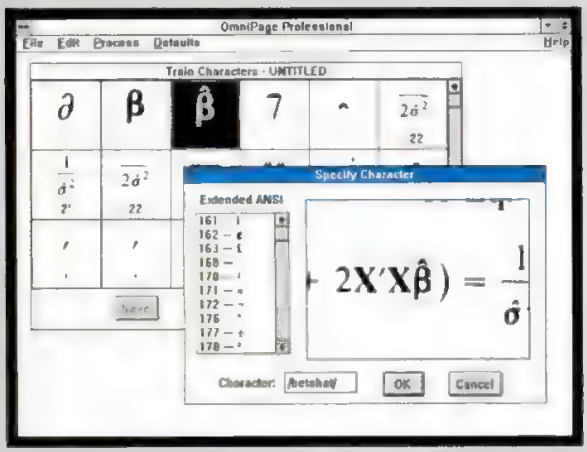
The original *OmniPage/386* pushed *Windows* 2.*x* past its limits by running in 16-bit mode. The two new versions slip out of a *Windows* 3.0 back door to use the 32-bit protected mode capabilities of the 386 chip while retaining enhanced-mode compatibility.

The last time we looked at *OmniPage/386*, it tied with Calera's *WordScan Plus* for Editors' Choice primarily because of its strong recognition power ("OCR Software Moves into the Mainstream," October 30, 1990). The leap to 32-bit mode operation has improved its recognition capabilities: They correctly recognize about one or two more words per paragraph than the previous version.

The increased overhead of *Windows* 3.0 seems to have pretty much wiped out any speed gains that *OmniPage Professional* might have achieved; it cruises along at about the same speed as its predecessor—marginally slower in a few cases—but it still remains substantially faster than *WordScan Plus* at most tasks.

In addition to the new memory management techniques, both packages incorporate the enhanced "zones" capability. While you could previously mark off different sections of a page for recognition, you can now specify the type of information the package should expect to find—alpha, numeric, or graphics—using an icon-based toolbox. More importantly, you can save customized "zone contents" files in which you can define custom character sets, including characters from the extended ANSI set.

That's where the similarity ends. Add-ins that supplemented *OmniPage/386:* the $100 *OmniDraft* (for dot matrix recognition) and the $100 *OmniSpell* (for spell checking) remain add-ins for Version 3.0 of that product. With *OmniPage Professional*, the add-ins are built in. Spell-checking can occur automatically or upon demand. Unfortunately, even though Caere has built *OmniDraft* capability into *OmniPage Professional*, recognition on dot matrix documents remains erratic.



OmniPage Professional allows you to train it to recognize and substitute aliases for unusual characters.

FACT FILE

***OmniPage Professional*, Version 1.0**
Caere Corp., 100 Cooper Ct., Los Gatos, CA 95030; 800-535-7226, 408-395-7000
List Price: *OmniPage Professional*, $995; *OmniPage 386*, Version 3.0, $695
Requires: 80386-based system or better, 4MB RAM, *Windows* 3.0.
In Short: Both *OmniPage* 3.0 and *OmniPage Professional* provide exceptional OCR accuracy as defined by current standards. If you can afford to ignore the $300 difference between them, you'll find that most recognition jobs can benefit from the extra capabilities of the more expensive *Professional*.

CIRCLE 711 ON READER SERVICE CARD

Professional has two new major capabilities that set it apart, not only from *OmniPage/386* 3.0, but from other products on the market as well. The first, the Verification window, allows you to correct errors in the file while viewing a bitmap of the image. *WordScan Plus* contains a similar feature, but *Professional* allows you to see the word in context—for that matter, any word in context—while *WordScan Plus* only lets you see the bitmaps of questionable characters.

The second major addition is Custom Character recognition, a character training option. To use it, you first perform recognition on a document, then call up the Train Characters dialog box, a grid containing bitmaps of the characters in question. You identify an unknown character by double-clicking on it (which pulls up a contextual bitmap of the character) and entering the desired keystrokes. For the extended ANSI characters that you can't type in from the keyboard or for foreign language characters that have no keyboard equivalents, you can enter an alias—such as "%gamma%"—that *Professional* will substitute whenever it encounters the associated character.

Caere certainly has a lot to be proud of with *OmniPage Professional*; for software that performs such complex tasks, it's extraordinarily easy to use. But there still remain some baffling omissions, and one irksome problem.

The problem? Both *OmniPage/386* 3.0 and *OmniPage Professional* require that you create a permanent *Windows* swapfile, an unsurprising request given the way the program skirts the edge of the *Windows* specification. But you can't create a permanent swapfile on any hard disk that uses anything other than 512-byte sectors. While we don't recommend this sort of nonstandard setup, if your system is configured in this way, you can't use either program.

As for omissions, both packages lack a preview mode, which makes it terribly difficult to fine-tune the contrast of a scan and wastes time if you've accidentally placed the document upside down or backward on the scanner. The package should let you flip the orientation as *WordScan Plus* does. Also, you have to wait about 30 seconds (with an HP ScanJet Plus) until the recognition procedure begins before you can abort the scan, change the contrast or orientation, and try again.

In addition, while both programs can save graphics to a graphics file, they can't break the graphics out and automatically save them to a separate file during the recognition process unless you define the graphics zone in advance.

The most important component of any OCR package is, of course, its recognition accuracy, a task at which both of the *OmniPage* packages excel. If you must choose between the two and you can afford the extra $300 for *OmniPage Professional*, you will probably be thankful for its extra capabilities. You won't go wrong with either one. ■

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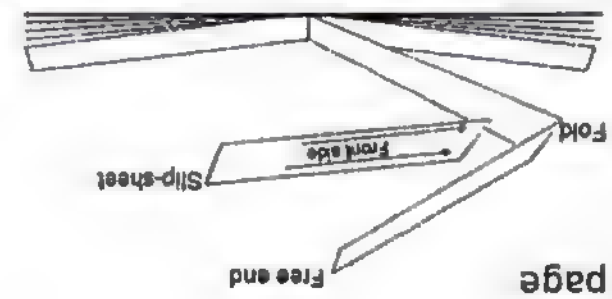
Folded edge of the page

Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

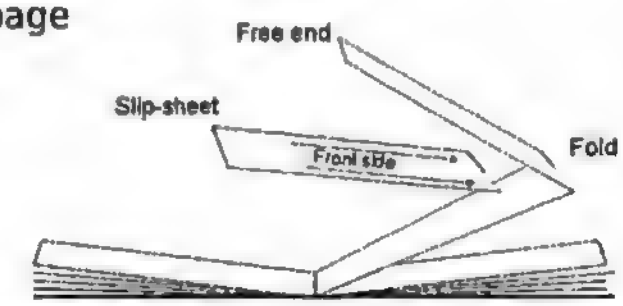


GbsSlipSheet-001

Folded edge of the page

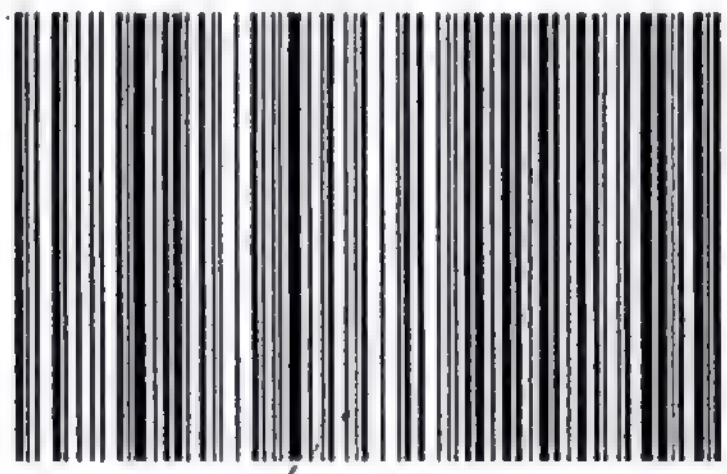
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
   1. Front side touching the free page
   2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Back

1. Follow instructions on the other side



Back

1. Follow instructions on the other side

YES, COMPLETE. $1295

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PC LABS BENCHMARK SERIES F

	Instruction Mix	Floating Point Calculation
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Compaq Deskpro 386S	4.48	9.67

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ZEOS IS THE LEADER

10 Good Reasons To Buy From ZEOS®

Reason #1
"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but four times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2
Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3
Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4
Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent." *Personal Computing* said, "ZEOS... is the best value we've come across... its performance is right up there with the slickest, most expensive PCs you can buy."

Reason #5
Warranties and Guarantees.

ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

Reason #6
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At ZEOS, the customer is #1. That's why we invented 24 Hour a Day Tech Support. For *your* convenience. If you buy a product from us we feel we should be there to help, any time of the day or night. Give us a call Toll Free! 800-423-5891. Anytime!

Reason #7
Experience.

Almost unique in the mail order computer industry, ZEOS maintains its own chip level Research and Development staff. In addition to Systems Manufacturing, we also operate our own Board Level Manufacturing facility.

ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8
A Sterling Reputation.

In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

Reason #9
Easy to Buy.

ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, American Express, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

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When it comes right down to it, you're going to be very satisfied with your new ZEOS system. Our goal is your complete satisfaction. And that's our commitment to you. To quality. To performance. To reliability and support. To *Value.* We don't just say it, *we Guarantee it!*

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PC-Kwik PowerPak Version 2.0 Offers Improved Memory Management

HANDS ON
by Daily Simon

With the release of Version 2 of its $129.95 *PowerPak*, Multisoft Corp. adds superb memory control to its set of high-performance enhancement utilities. *PowerPak* includes a RAM disk, print spooler, keyboard and screen speedup, but the showpiece of the collection is its *PC-Kwik* disk cache. The cache can use conventional, extended, or expanded memory to store recently used disk data in RAM.

Part of the cache's spectacular performance stems from its ability to do disk writes in the background. This is different from—and safer than—other cache programs that delay disk writes. With *PC-Kwik*, the cache immediately starts writing to disk but returns control to you when it is writing in the background.

Other portions of the program incorporate some attractive features. The keyboard speedup includes ReDOS, a DOS command line editor with a pop-up list of your recent DOS commands. The screen utility includes a scrollback buffer and a screen blanker. And, while new features have been added, there is no increase in program size. In fact, on my system, conventional memory usage dropped from 47K to 42K.

As in the previous version, *PowerPak*'s components can share memory with the cache. New in this version is the cache's ability to lend memory to *Windows* and to programs requesting EMS.

The cache manages a large pool of memory that can often be megabytes in size. You can set aside memory to be shared by the RAM disk, ReDOS command history, or by the scrollback buffer.

More important, and new to this version, is that memory not set aside for sharing becomes the cache's lending area. The cache will give that memory to the spooler as needed, but it will also monitor requests by programs for EMS memory and will relinquish memory for that purpose if the cache is in EMS. Similarly, if the cache is in extended memory, it will give up the memory to *Windows*, as *SMARTDrive* does.

The *PowerPak* programs will also use the high memory area set up by 386 memory managers. They do this without your having to use the memory manager's loadhi capability, which simplifies memory setup and allows you to shoehorn into tighter memory areas. ■

List Price: *PowerPak*, Version 2.0, $129.95; upgrades from Version 1.*x*, $29.95; cache is available separately under the name *Super PC-Kwik*, $79.95. **Requires:** 128K RAM, DOS 2.0 or later. Multisoft, 15100 SW Koll Pkwy., Beaverton, OR 97006; 800-234-5845, 503-644-5644.

CIRCLE 705 ON READER SERVICE CARD

Presentation Team Matures Into Integrated Environment

HANDS ON
by Rock Miller

If the trend in business graphics software is toward entire presentations rather than individual charts, Digital Research's *Presentation Team* is at the height of fashion. With integrated charting, drawing, and word charting in one graphical environment, this $395 *GEM*-based program offers the advantages of a GUI to ordinary DOS users.

The new version integrates what were disparate modules. Though presentations are in fact made up of separate "visuals," all of the files related to a given presentation are kept in a common subdirectory, called up with a single operation. The program doesn't give you a thumbnail view of your images, but you can easily select images, reorder them, or borrow them from other presentations.

Presentation Team has extensive word-charting capabilities. Draw a box on your visual, and a word-chart entry screen pops up with boxes for entering text. Each paragraph can be assigned a style (which specifies font, color, border, outline style, bullets, etc.). A simple icon and ruler bar makes it easy to place tabs, indents, and column stops by dragging these elements. Menu settings give you intimate control over leading and bullet styles. *Presentation Team* ships with a comprehensive set of word-chart templates, any of which can be modified to suit your needs.

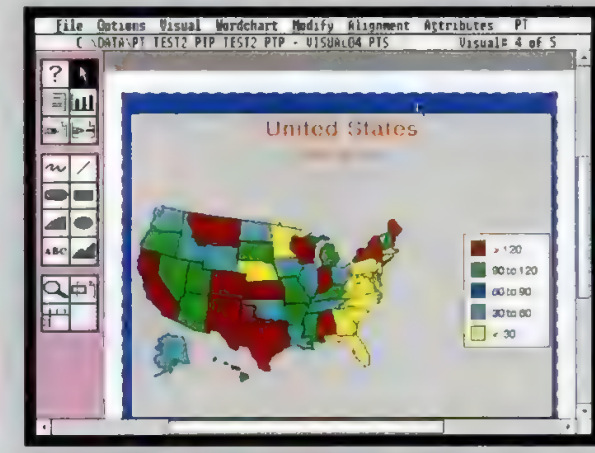
Presentation Team is equally strong when it comes to drawing. It does not offer node editing, but it has everything else you'd need in simple drawing and editing tools. Line weights and border thicknesses are continuously variable. It comes with a good selection of clip art, and though it can import only .GEM and .IMG files, the program comes with a customized version of *Hijaak* to convert most graphics file formats.

The program lags in data charting, however. Though it has all the basic business charts plus some specialties—including symbol and thematic map charts—the inflexibility and poor design of the module make creation time-consuming. There are no direct links to worksheet files. And, though you can do limited moving of legends, labels, and such on the live graph, real control requires that you convert the graph into a picture, which unlinks it from the underlying data.

Another weakness is output. Though it supports LaserJets and dot matrix printers, there's no draft mode, so you can't print on a standard 512K LaserJet with the default 300-dpi driver, even using the half-page option. The program comes with two Bitstream Fontware outlines (Swiss and Dutch) in all styles, but there's no way to tell what sizes you've installed, and printing handouts (four to a page) requires you to generate a complete set of half-size fonts as well. Using PostScript avoids these difficulties, and the built-in link to Magicorp's slide service produces nice results. ■

List Price: *Presentation Team*, Version 2.0, $395. **Requires:** 640K RAM, hard disk, graphics adapter, mouse, DOS 3.1 or later. Digital Research Inc., P.O. Box DRI, 70 Garden Ct., Monterey, CA 93942; 408-646-3896.

CIRCLE 713 ON READER SERVICE CARD



***Presentation Team* offers charting options, but is strongest in word charting.**

V-ATE Board Offers Rx for Ailing Motherboards

HANDS ON
by Stephen W. Plain

Wouldn't it be nice if you could fully diagnose motherboard problems by plugging a board into a 16-bit ISA slot? The V-ATE board from Vista Microsystems lets you do just that. It's the first low-cost PC diagnostic tool that tests all of the signals available on the ISA bus.

The V-ATE comes in three flavors. The model 1000 is primarily a tool for technicians who need to make quick, high-level evaluations of motherboard and power supply problems. The model 2000 and model 4000 each contain a built-in 72-channel logic analyzer that examines all the signals on the AT bus. The analyzer on the model 2000 is 2K deep and runs at 15 MHz. The model 4000's is 4K and operates at 30 MHz for a faster, more accurate picture of what's going on across the bus.

All of the V-ATE models have an Intel 8051 processor and voltage comparators to test voltage levels delivered to the bus. The V-ATE emulates all hardware interrupts, as well as DMA channels 0 through 7, bus mastership, and 0 wait state operation. The keyboard is simulated, with loopback tests that check the integrity of the keyboard controller.

In addition to the broad range of built-in tests, users can download their own test code. Library functions available from Vista allow customization of the V-ATE board.

The V-ATE board can be used in two basic configurations. In standalone mode, errors can be detected either with a monitor attached to the unit under test or from the LED display on the board. The *V-CON* software, however, really illustrates the power of the V-ATE. The software runs on a remote computer and communicates with the unit under test via a supplied serial cable. *V-CON* allows a user to select which tests to run, to decide whether to loop tests, and to use the logic analyzer functions.

The logic analyzer can be triggered manually or by specific tests as they run. Data can be displayed as waveforms, or as a vertical representation of the signal states. The disassemble option provides a view of the assembly code of operations.

The V-ATE is the first PC product which combines such low-level diagnostic capabilities with flexibility over various testing applications. PC Magazine Labs testing uncovered subtle incompatibilities and design shortcuts in various machines under V-ATE evaluation. *PC Magazine* readers can now look forward to an even more thorough examination of PCs in the future, thanks to this useful tool. ■

List Price: V-ATE 1000 Field Service/Inspection System, $995; V-ATE 2000 Manufacturing Test System, $1,495; V-ATE 4000 Advanced Manufacturing Test System, $1,995; V-ATE 1000 to 2000 upgrade kit, $595; V-ATE 1000 to 4000 upgrade kit, $1,095. **Requires:** 16-bit ISA bus slot. Vista Microsystems Inc., 6 Whipple St., N. Attleboro, MA 02760; 508-695-8459.

CIRCLE 701 ON READER SERVICE CARD

AccuDraw: A $150 WP Partner

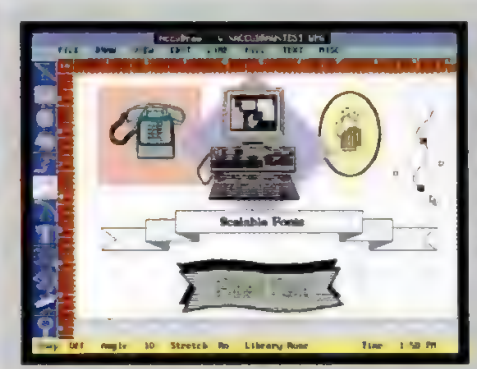
HANDS ON
by Robert Kendall

WordPerfect users will welcome a new release of Athena Technologies' *AccuDraw for WordPerfect*, a $149.95 drawing adjunct to the word processor. The package is aimed at users who want to touch up or create graphics in *WordPerfect*'s vector-based, .WPG format, but don't need presentation features—such as charting and screenshow—found in WordPerfect Corp.'s own, higher-priced *DrawPerfect*. *AccuDraw*'s lower price also reflects its lack of printer support, a logical omission for users who do all their graphics printing from within *WordPerfect*.

You won't have to sacrifice drawing power, though. *AccuDraw* puts enough solid functionality at your disposal to handle most drawing tasks.

As you might expect from a *WordPerfect* companion program, *AccuDraw* lets you select draw functions from pull-down menus. *WordPerfect* aficionados may be annoyed at not being able to use the Alt key to pull menus down, but there are speed keys for most options. Toolbox icons provide access to important drawing features.

All the expected graphics primitives functions are here, and there's even an option for creating boxes with rounded corners using five different corner sizes. You have several line styles in 64 thicknesses, as well as 64 fill patterns, though you're limited to 16 colors.



AccuDraw for WordPerfect provides a painless way to create and edit .WPG files.

The .WPG format doesn't support Bezier curves, but *AccuDraw* lets you create shapes as Beziers and then store them as line segments. An especially nice touch lets you sketch something freehand and then fine-tune the curves as Beziers. You can also convert freehand shapes into polygons.

You can group, select background and foreground, or automatically align objects in numerous ways. Customizable rulers and a snap-to-grid feature facilitate placement. Objects can be rotated to any angle.

More exotic functions will create symmetrical patterns by stamping multiple copies of an object at different angles of rotation or mirroring objects.

The only fonts available are Courier, Times Roman, and Helvetica, but they come in point sizes of 1 to 200 with a wide variety of attributes. Fill patterns can be applied to them.

Nonartists will find the clip-art library of over 400 color images very useful. You can add to the well-organized library, preview the images sequentially at reduced size, and break apart images into editable parts.

To bring an *AccuDraw* file into a *WP* document you simply use *WP*'s graphics menu and enter the filename. The package includes some *WP* macros that prompt you for the name of the *AccuDraw* file and automatically create a document with the embedded .WPG file in either landscape or portrait mode.

AccuDraw offers value to *WordPerfect* users, packing a wealth of editing power into a low-priced package. It should help legitimize the .WPG format and offer midrange users a *DrawPerfect* alternative. ■

List Price: *AccuDraw for WordPerfect*, Version 2, $149.95. **Requires:** 384K RAM, graphics display, DOS 2.0 or later, mouse or tablet. Athena Technologies Inc., 160 E. Main St., Westboro, MA 01581; 800-525-3577.

CIRCLE 440 ON READER SERVICE CARD

Quick, name the world's best memory manager:

NETROOM!

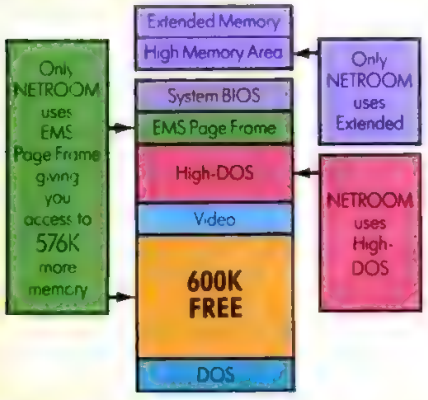
Right!

PC MAGAZINE EDITORS' CHOICE
Jan 29, 1991

If you thought the answer is QEMM® or 386MAX®, think again. Because **NETROOM®** just beat them both, by winning PC Magazine's prestigious Editors' Choice award.

PC Magazine said† *"With its versatility, this $149 four-user version rates as a real winner. Considering NETROOM's price and capabilities, you will find that there is no second choice."*

What makes **NETROOM** a winner is that it is more than a great LAN manager. It is a full-featured memory manager that not only relocates LANs (like Novell, VINES®, etc.), it also moves device drivers, and TSRs into extended, expanded, and high-DOS memory.



Features:	NET-ROOM	QEMM	386 MAX
Windows 3.0 support	✔	✔	✔
Multiuser license	✔		
Converts Ext. to Exp.	✔	✔	✔
Relocates to High-DOS	✔	✔	✔
Relocates to LIM 3.2 Frame	✔		
Relocates to Expanded	✔		
Relocates to Extended	✔		
Works on 386/486	✔	✔	✔
Works on 8088/286	✔		
Memory Analysis Utility	✔		

And, **NETROOM** is the only memory manager than runs on all PCs (8088 through 80486).

But, there's more...PC Magazine says it's *"The most flexible product we tested,"*...and... *"NETROOM uses a unique swapping feature to access data and programs in extended or expanded memory...Even PCs with tightly jammed high-DOS areas can benefit from the memory swapping capabilities of NETROOM."*

And to top it all off, with **NETROOM** you will get absolutely FREE – **DISCOVER®**, an excellent utility that makes installation a pleasure and provides a detailed, real-time view of the memory configuration and possibilities within a PC.

CIRCLE 313 ON READER SERVICE CARD

PC Magazine says *"Netroom's $149 price for four users is a steal."* So, go out and steal yourself a copy!

Available from Helix or at your local dealer.

Requirements: A 386, or some EMS 3.2 or EMS 4.0 memory hardware, or at least 64K ext. memory and DOS 3.3 or greater

1-800-451-0551

*Single User, 4 User $149, 10 User $249 plus $5 per order shipping & handling

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MicroLab computers are renowned for their industry leading technology, performance and pricing.

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- 160MB Hard Disk Drive
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40MB - 1:1 Interleave	$2995	$3045	$3145	$3295	$3345	$3395	$3495
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85MB - 1:1 Interleave	$2345	$2395	$2495	$2645	$2695	$2745	$2845
80MB - 1:1 Interleave	$2545	$2595	$2795	$2945	$2995	$3045	$3145
120MB - 1:1 Interleave	$2745	$2795	$2895	$3045	$3095	$3145	$3245
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85MB - 1:1 Interleave	$1845	$1895	$1995	$2145	$2195	$2245	$2345
80MB - 1:1 Interleave	$2145	$2195	$2295	$2445	$2495	$2545	$2645
120MB - 1:1 Interleave	$2245	$2295	$2395	$2545	$2595	$2645	$2745
160MB - 1:1 Interleave	$2645	$2695	$2795	$2945	$2995	$3045	$3145
320MB - 1:1 Interleave	$3245	$3295	$3395	$3545	$3595	$3645	$3745

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30MB - 1:1 Interleave	$1345	$1395	$1495	$1645	$1695	$1745	$1845
40MB - 1:1 Interleave	$1395	$1445	$1545	$1695	$1745	$1795	$1895
65MB - 1:1 Interleave	$1495	$1545	$1645	$1795	$1845	$1895	$1995
80MB - 1:1 Interleave	$1795	$1845	$1945	$2095	$2145	$2195	$2295
120MB - 1:1 Interleave	$1895	$1945	$2045	$2195	$2245	$2295	$2395
160MB - 1:1 Interleave	$2295	$2345	$2445	$2595	$2645	$2695	$2795
320MB - 1:1 Interleave	$2895	$2945	$3045	$3195	$3245	$3295	$3395

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MICROLAB 286/12 Price Matrix	Mono-Chrome 12" 720x350	Mono-Flat 14" 720x350	CGA Color 14" 640x200	EGA Color 14" 640x350	VGA Color 14" 640x480	VGA Multi 14" 800x600	VGA Hi-Res 14" 1024x768
30MB - 1:1 Interleave	$ 895	$1045	$1145	$1295	$1345	$1395	$1495
40MB - 1:1 Interleave	$1045	$1095	$1195	$1345	$1395	$1445	$1545
65MB - 1:1 Interleave	$1145	$1195	$1295	$1445	$1495	$1545	$1645
80MB - 1:1 Interleave	$1445	$1495	$1595	$1745	$1795	$1845	$1945
120MB - 1:1 Interleave	$1545	$1595	$1695	$1845	$1895	$1945	$2045
160MB - 1:1 Interleave	$1945	$1995	$2095	$2245	$2295	$2345	$2445
320MB - 1:1 Interleave	$2545	$2595	$2695	$2845	$2895	$2945	$3045

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Video Options — Include Monitor & Video Card

MICROLAB XT/12 Price Matrix	Mono-Chrome 12" 720x350	Mono-Flat 14" 720x350	CGA Color 14" 640x200	EGA Color 14" 640x350	VGA Color 14" 640x480	VGA Multi 14" 800x600	VGA Hi-Res 14" 1024x768
30MB - Hard Disk	$ 745	$ 795	$ 895	$1045	$1095	$1145	$1245
40MB - Hard Disk	$ 795	$ 845	$ 945	$1095	$1145	$1195	$1295
65MB - Hard Disk	$ 895	$ 945	$1045	$1195	$1245	$1295	$1395
80MB - Hard Disk	$1195	$1245	$1345	$1495	$1545	$1595	$1695
120MB - Hard Disk	$1295	$1345	$1445	$1595	$1645	$1695	$1795

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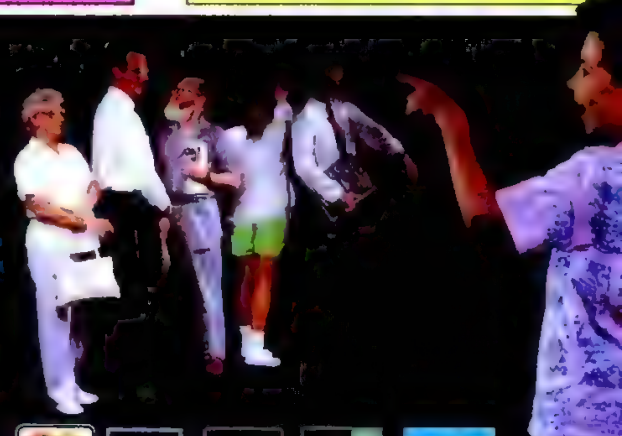

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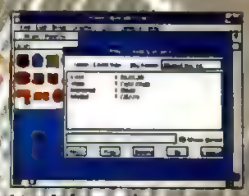
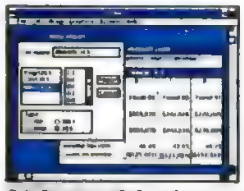
THINX SMART: Thinx takes data and represents it as graphic images.



Behind each image is an array of data that you input.

By linking information to images, Thinx™ software, for the first time, allows you to manipulate streams of complex data simply by moving those images. Now "Intelligent Graphics" can be used to form connections, find relationships and make judgments. For instance, offices, equipment, furniture, and people all have an effect on a building's cost, profitability and countless other aspects of its operation. Yet, with Thinx, all this can be represented and analyzed by manipulating a graphic image of the building.



Link several databases and spreadsheets and use all the data at once.

THINX FAST: Thinx works the way you like, with Windows* and the leading spreadsheets and databases.

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We're More Than Just Talk.

by Cristina Córdova and Nate Zelnick

New&Improved

News of Announced Products and Upgrades

MEC Launches Graphics Word Processing System for Windows 3.0

NEW A new WYSIWYG word processing system, **Microsystems Engineering's** *WysiWord* combines word processing with technical illustration and business graphics capabilities. Designed as a multiplatform system, *WysiWord* takes advantage of *Windows* amenities such as pull-down menus and graphics icons. Use of identical file formats under all platforms facilitates data exchange.

Although *WysiWord* is positioned as a "free-form" WYSIWYG word processor, the system also generates illustrations and data-driven business graphics. Graphics in PICT, HPGL, CGM, Tektronix, and Lotus PIC formats can be imported, edited, annotated, and scaled to fit anywhere in a document.

A technical drawing editor enables you to create complex drawings or line art for organizational and flow charts. You can also create a variety of graph types from imported spreadsheet and database files. Conversions to and from other word processor file formats (for example, *DisplayWrite*, *Microsoft Word*, and *WordPerfect*) will be available.

List Price: *WysiWord*, $895. **Requires:** 2MB RAM, *Windows* 3.0. Microsystems Engineering Corp., 2400 W. Hassell Rd., #400, Hoffman Estates, IL 60195; 708-882-0111.

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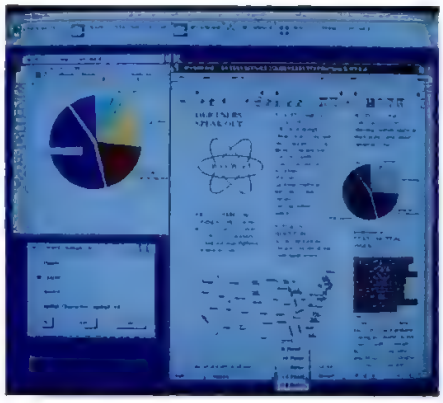


***WysiWord* integrates illustrations and graphics with WYSIWYG word processing.**

Ventek Introduces a 24-bit Color Video Capture Subsystem

NEW Especially useful to desktop publishers, animators, and picture database users, **Ventek's** VIP 640C video digitizer board captures resolutions of 640-by-480 pixels with over 16 million colors and 256 gray levels. Graphics can be captured as 24- or 8-bit color images, or as 8-bit monochrome images. The new board allows easy and effective capture, manipulation, and storage of images from any S-Video or NTSC video source.

To complement the board's capabilities, Ventek has bundled the VIP 640C with *FOTOfiler*, a graphics database program, and *Picture Publisher Plus*, a color image editing program. The accompanying VIP *Capture Control and Setup* software saves in file formats that are compatible with all popular applications (TIFF and .TGA).

List Price: VIP 640C, $449. **Requires:** 286-, 386-, or 486-based PC, ISA bus, VGA. Ventek Corp., 31336 Via Colinas, #102, Westlake Village, CA 91362; 818-991-3868.

CIRCLE 434 ON READER SERVICE CARD

HOT PROSPECT

ATI TECHNOLOGIES' 8514/ULTRA CARD BUILDS IN CRYSTAL FONT-SCALING TECHNOLOGY

Priced as low as $599, **ATI Technologies'** new 8514/Ultra offers an interesting solution to the WYSIWYG schism between monitors and laser printers. Its hardware-based, on-screen anti-aliasing uses 16 levels of gray scale to give the appearance of 300-dot-per-inch output. The proprietary Mach 8 graphics coprocessor generates scalable fonts on-board, rather than going to the system's CPU. According to ATI, this accounts for a conversion rate of 2,400 characters per second on a 6-MHz PC-AT.

The 8514/Ultra is one of the first flip-flop boards.

In addition, the 8514/Ultra, with 1MB of dual-ported VRAM, supports resolutions of up to 1,024 by 768 pixels with 16 or 256 simultaneous colors in both interlaced and noninterlaced signal output. Designed with both Micro Channel and ISA edge connectors, it is among the first flip-flop boards. ATI also offers a $699 version with integrated VGA circuitry and mouse support.

List Price: ATI 8514/Ultra with 512K, $599; with 1MB, $799. ATI Technologies Inc., 3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W 3S2; 416-756-0718.

CIRCLE 432 ON READER SERVICE CARD

MiniSys 2000 Saves Money and Desk Space

NEW **SIIG** has introduced the MiniSys 2000, a conventional workstation that also serves as a platform for vertical applications that require a compact PC. Measuring 3.6 by 5.5 by 12.2 inches (HWD), the 9-pound MiniSys 2000 is a full-featured 80286-based system.

The standard configuration, priced at $495, includes 1MB RAM (expandable to 2.5MB), a 1.44MB 3.5-inch drive, IDE and floppy drive interfaces, a Hercules- and CGA-compatible graphics adapter, and a silent mini-external power supply adapter. Also featured are two serial ports, one parallel, and one game port. External connectors allow you to attach an external floppy drive and a TV adapter.

The system has one 3.5-inch drive bay for an additional hard disk, and one three-quarter-length 16-bit expansion slot that accepts standard bus cards.

SIIG offers standard-size peripherals for the MiniSys 2000—a 14-inch AS1401 monochrome monitor and Suntouch 101-key enhanced keyboard—as well as miniature peripherals—a 9-inch AS901 monochrome monitor and the Suntouch Jr. 84-key keyboard. In addition, an external 5.25-inch floppy disk drive and a multiexpansion chassis are available.

List Price: MiniSys 2000, $495; including set of peripherals, $725. SIIG Inc., 5369 Randall Pl., Fremont, CA 94538; 415-657-0567.

CIRCLE 435 ON READER SERVICE CARD

BRIEFS

PORTABLE PCS

Advanced Logic Research has entered the notebook market with the VENTURE 16 PC. Measuring 2 by 12 by 8.6 inches (HWD), the 7-pound notebook is a 16-MHz 386SX-based system with 1MB RAM (expandable to 5MB), a 1.44MB 3.5-inch floppy drive, a 20MB ($2,795) or 40MB ($3,295) hard disk, and a VGA LCD with 640-by-480 resolution. 714-581-6770.

Dauphin Technology's line of laptops, the Dauphin 1000 series, are the first 6.5-pound modular laptops. The systems, including a diskless workstation, have detachable screens, upgradable CPUs (from a 12-MHz 286 to a 25-MHz 386) and network-ready architecture. Prices range from $3,295 to $5,795. 708-627-4004.

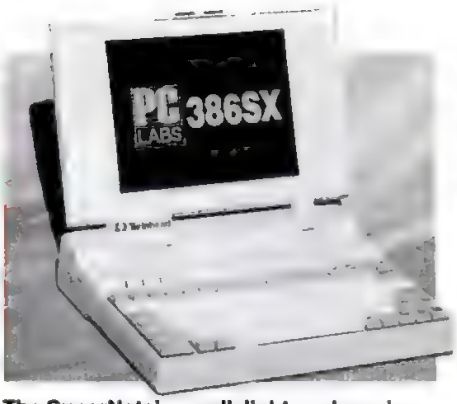
GoldStar Technology is shipping the GS520, a 16-MHz 386SX-based laptop priced at $3,495. Featuring a 40MB hard disk and a 1.44MB 3.5-inch floppy disk, the 12.8-pound GS520 offers 1MB RAM (expandable to 4MB) and a VGA LCD with 16 gray levels and 640-by-480 resolution. 408-432-1331.

DRIVES

CD Technology announced its new HD Porta-Drive 200. Based on the CP-3200F drive mechanism, the HD Porta-Drive has a storage capacity of 200MB. Priced at $1,995, the portable hard disk weighs less than 4 pounds and has a claimed access time of 15 milliseconds. 408-432-8698.

JVC has designed a hard disk drive for use with compact, high-performance laptops. The 42.5MB HDD Model JD-E2850P is a high-density 2.5-inch drive with a built-in controller. Available for $795, the drive has an average speed of 25 milliseconds. 714-965-2610.

Racet has announced its first DAT drive. Retailing for $4,995, the drive features a data storage capacity of 1.3GB and an average file access time of 20 milliseconds. The 3.5-inch form factor, half-height drive uses the ANSI Digital Data Storage format. It includes a selectable SCSI-1 and SCSI-2 controller interface which provides a 512K data buffer (expandable to 1MB). 714-579-1725.



The SuperNote's small, light package is loaded with a host of functions.

Slim 386SX SuperNote Sports VGA Displays

NEW Designed around **Twinhead Corp.**'s own single chip version of the AT chip set, the SuperNote is a 16-MHz 80386SX-based notebook PC. Priced at $3,595, the 6.5-pound (battery included) SuperNote comes with a 40MB (20MB optional), 3.5-inch hard disk drive, and a paper-white VGA LCD that supports 32 gray shades in 640-by-480 resolution.

In its standard configuration, the SuperNote has 2MB RAM (4MB optional), expandable to 8MB, and a 1.44MB 3.5-inch floppy disk drive. It is also socketed for an optional 80387SX math coprocessor. One parallel and two serial ports, an external analog monitor port, a floppy drive socket, memory and the 32-bit CPU are all integrated into a compact four-layer system board. Twinhead packages the SuperNote with DOS 4.01, disk caching software, a file-transfer utility, and a nylon and leather carrying case.

To maximize the SuperNote's battery life, Twinhead utilizes D cells in its nickel cadmium battery pack. Like Twinhead's Slimlap PC, the SuperNote has three charging modes—rapid, quick, and trickle charge. The charging circuitry is intelligent; as the nickel cadmium batteries reach maximum stored charge, the AC adapter changes modes to trickle. Fully charged, the SuperNote will run for about 3.5 hours.

List Price: SuperNote, $3595. Twinhead Corp., 1537 Centre Pointe Dr., Milipitas, CA 95035; 408-945-0808.

CIRCLE 436 ON READER SERVICE CARD

PeeWee 286 Offers Transportable Power

NEW For easy transportability, **SAI Systems Laboratories** has designed a compact 12-MHz 286 PC called the PeeWee 286. Measuring 1.75 by 10 by 8 inches (HWD), the system weighs 5 pounds and retails for $1,295. The PeeWee 286 offers a 40MB Intelligent IDE hard disk (upgradable to 200MB), 1MB RAM (expandable to 2MB), and a high-density, 1.44MB 3.5-inch floppy disk. Other features include mono/color or optional VGA (800 by 600) video adapters, two RS-232C serial and printer ports, 0 wait-state operation with dual processor speeds, and a built-in switching power supply. An optional 14-inch monitor is available from SAI.

List Price: PeeWee 286 PC, $1,295. SAI Systems Laboratories Inc., 911 Bridgeport Ave., Shelton, CT 06484; 203-929-0790.

CIRCLE 437 ON READER SERVICE CARD

Maynard Debuts 3.5-Inch Form Factor 2GB DAT Backup System

NEW Maynard has introduced the first 3.5-inch form factor 2.0-gigabyte DAT backup system. Designed specifically for the rigors of data storage environments, **Maynard's** MaynStream 2000 DAT subsystems are advanced, fully integrated, ANSI Digital Data Storage (DDS) tape drives. The drives support SCSI interfaces and are available as external or internal units.

As with Maynard's other DAT products, tape speed, motion, and tension are electronically controlled over four direct motors.

The internal MaynStream 2000 DAT drive measures 1.6 by 5.7 by 7.9 inches (HWD).

Because it does not use belts, the drive operates silently and incurs less wear on parts. Four custom ASIC chips provide on-board intelligence and control in a minimum of space, while a four-head design offers the advantages of read-after-write check.

Maynard packages its MaynStream DAT drives as complete data solutions, including controller cards and *MaynStream* 3.0 software. The extensive list of software features includes unattended backup, remote network workstation data backup, tape cataloging, new memory management, password protection, error correction, and foreign language support. The system also supports DOS-like commands for execution from batch files. In addition, *MaynStream* 3.0 supports backup and restoration of *Novell* bindery folders and is *Novell 286* and *386* certified.

List Price: MaynStream 2000 DAT, $5,495 to $6,195. Maynard Electronics Inc., 36 Skyline Dr., Lake Mary, FL 32746; 800-821-8782, 407-263-3500.

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Full-featured notepad. Lets you check your spelling and even consult an online thesaurus.

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BRIEFS

MICE

Z-Nix Co. uses infrared technology for its new battery-powered Cordless Super Mouse. With a resolution of 400 characters per inch, the two-button mouse costs $164.95 and comes with a built-in intelligent driver and two rechargeable batteries—each provides eight hours of work time. 714-629-8050.

Mouse Systems Corp. has teamed up with **Mitsubishi Corp.** to introduce the Stealth Mouse for $129. The two-button mouse has a selectable resolution of 100 to 400 cpi. With Mouse Systems' Ultra-Res driver software, resolution is variable from 20 to 6,400 cpi. 408-727-0351.

Appoint has introduced the MousePen Professional. The mouselike mechanism ($109) is a pen-shaped pointing device that functions at any angle on any soft surface that a pen will write on. An external switch allows you to choose resolutions from 100 to 1,000 cpi. Low power requirements make the MousePen Professional suitable for use with laptop and notebook PCs. 805-239-8976.

GRAPHICS

New Media Graphics' Super Still-Frame Compression Board is now available for $995. The board performs standard JPEG compression and decompression on still-frame color images. The incorporated C-Cube Microsystem's CL550 image compression processor enables compression ratios of 8:1 to 75:1. Users can directly compress files from within ICI-compatible formats. Running under DOS 3.3 or later, the board supports TGA file formats. 800-288-2207, 508-663-0666.

Xing Technology has developed a gray-scale and full-color image compression software package called *VT-COMPRESS*, which retails for $179. Complying with the ISO/CCITT JPEG still-image compression standard, the software can compress images by ratios of up to 100:1. *VT-COMPRESS* supports TARGA and TIFF file formats. 805-473-0147.

386SX with 32K RAM Cache Runs at 20 MHz

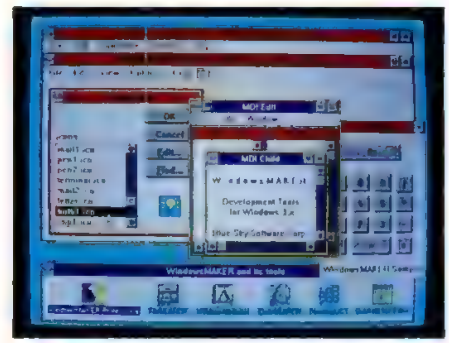
NEW The **Micro Express** ME 386SX/20 has a new sibling—the ME 386SX/20/Caching system. Equipped with a 32K RAM cache, the new PC offers page-mode interleaved memory with 0 wait states for highest performance.

The ME 386SX/20/Caching, priced at only $999, is packaged in a compact case measuring 6.5 by 14.5 by 16.5 (HWD). Standard features include 1MB RAM (expandable to 32MB); a 32K RAM cache; a 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive; one parallel and two serial ports; and a 200-watt power supply. The system has eight expansion slots and a socket for either an 80387SX or Weitek math coprocessor. You get a choice of either an enhanced 101-key keyboard (with or without audible feedback), or a keyboard with a built-in trackball mouse. **List Price:** ME 386SX/20/Caching, $999. Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 714-852-1400.

CIRCLE 439 ON READER SERVICE CARD

WindowsMAKER : A Desktop Programming Tool for Windows 3.0

NEW Users can now design their own user interfaces by simply drawing them visually on the screen. **Blue Sky Software Corp.**'s *WindowsMAKER Professional* sells for $995, but registered *WindowsMAKER* users can purchase it for $240. *WindowsMAKER Professional* allows you to interactively design attractive screens, menus, and data entry forms. The software also lets you prototype, animate, and test *Windows* programs in a WYSIWYG environment. Once a prototype is complete, the software produces code for standard programming languages and generates all the production files necessary to compile a native *Windows* application. *WindowsMAKER Professional* supports Zortech C++, Version 2.1, and Glockenspiel C++, Version 2.0, in addition to Microsoft C 5.1 and C 6.0. **List Price:** *WindowsMAKER Professional*, $995; for registered *WindowsMAKER* users, $240. **Requires:** *Windows* 3.0 or later, *SDK* 3.0 or later, Microsoft C 5.1 or 6.0 or later or Zortech C++ 2.1. Blue Sky Software Corp., 2375 East Tropicana Ave., #320, Las Vegas, NV 89119; 702-456-6365.



***WindowsMAKER Professional* gives you control over the look and feel of your *Windows* applications.**

CIRCLE 710 ON READER SERVICE CARD

OSFrame Adds a New Dimension to Windows

NEW Taking the 3-D look further than before, *OSFrame*—**Playroom Software's** utility program for *Windows* 3.0—gives title bars, borders, and menu boxes a 3-D visual effect. The $28.95 program controls all of these effects through a control panel similar to the *Windows* Control Panel color window.

Playroom Software packages *OSFrame* with VGA drivers that help *Windows* look like the Macintosh, NeXT, or OSF/Motif environment. Once the program is configured, it automatically makes itself an integral part of *Windows*. **List Price:** *OSFrame*, $28.95. **Requires:** *Windows* 3.0, 10K RAM. Playroom Software, 7308-C E. Independence Blvd., #310, Charlotte, NC 28227; 704-536-3093.

CIRCLE 441 ON READER SERVICE CARD

CommonKnowledge Helps Solve Problems

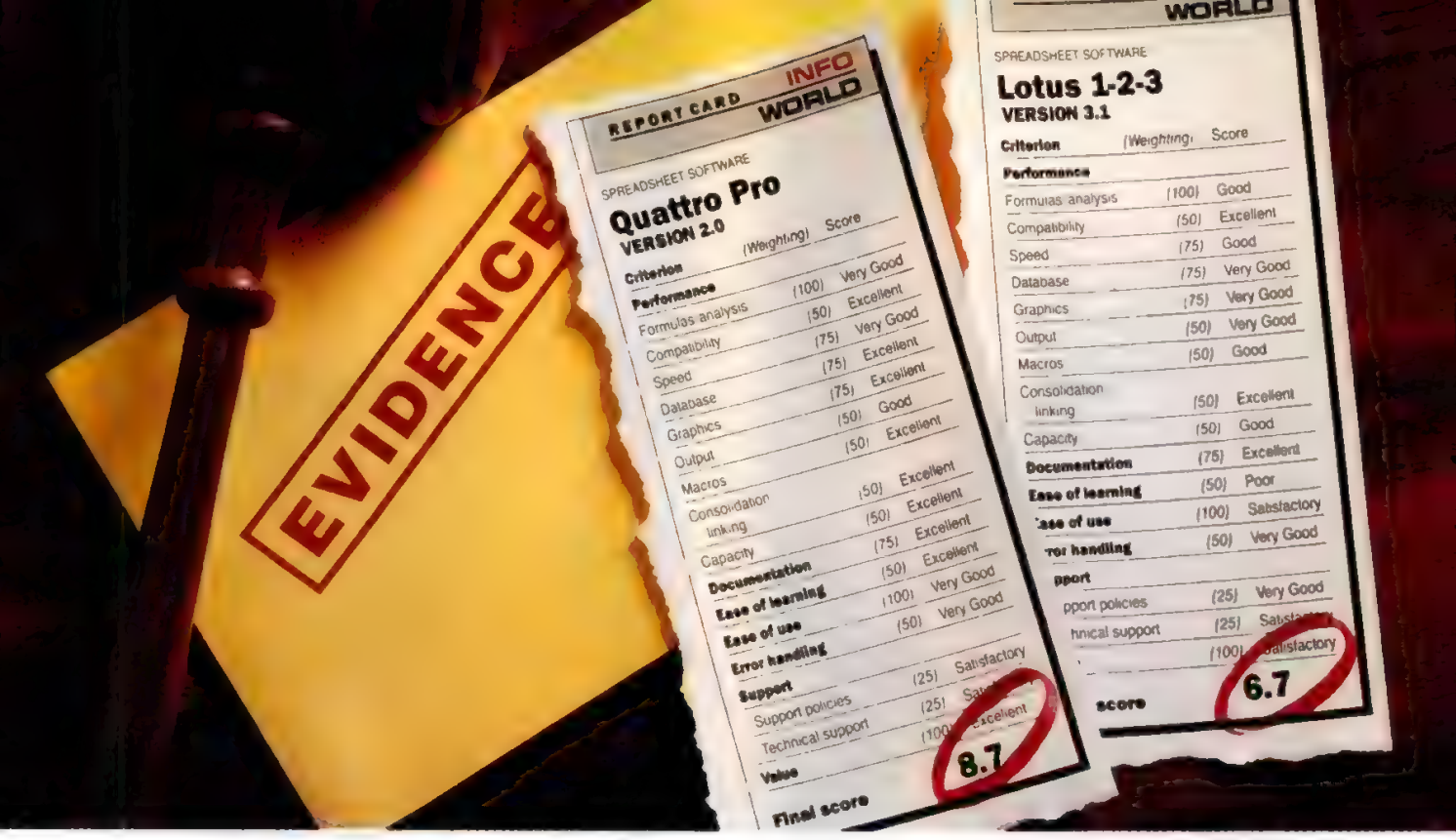
NEW *CommonKnowledge*, an application development tool from **Wang Laboratories**, enables users to create, distribute, and maintain decision-making or problem-solving applications in a workgroup.

Running on ISA- or MCA-based PCs, *CommonKnowledge* allows users with little experience to create complex applications. It uses a conversational method to assist the application developer in organizing knowledge and building a complete knowledge base.

CommonKnowledge applications are flexible, allowing developers to adapt them easily to changes in the decision-making process or procedure. These applications can be integrated with DOS files, including image files in standard formats, such as TIFF, .PCX, and WIFF, and with user-written subroutines as well. ■

List Price: *CommonKnowledge*, development and runtime components, $950; runtime component only, $150 per user or $750 for a site license. **Requires:** 640K RAM, 2MB extended memory, hard disk, 1.2MB 5.25-inch or 720K 3.5-inch floppy disk drive, DOS 3.2 or later. Wang Laboratories Inc., One Industrial Ave., Lowell, MA 01851; 508-459-5000.

CIRCLE 442 ON READER SERVICE CARD



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"Quattro® Pro provides more features and better performance than 1-2-3 . . ."

***BYTE*, November 1990**

"Quattro Pro offers some of the most powerful charting and best-quality output you'll see in a spreadsheet today." ***PC Magazine*, December 1990**

"Overall, Quattro Pro has the best set of database features we've seen in a spreadsheet."

***InfoWorld*, December 1990**

"Quattro Pro 2.0 also offers more interactive presentations, a more flexible desktop environment and smaller RAM requirements."

***PC Week*, October 1990**

Lotus® 1-2-3® r 3.1

". . . only masochists need to try [1-2-3, Rel. 3.1]. Performance was so sluggish on a 1Mb Compaq 386™/20 that we gave up after half an hour."

***InfoWorld*, October 1990**

". . . it [Lotus 1-2-3 Release 3.1] doesn't have everything you expect from a graphical interface. . .

***PC World*, September 1990**

". . .(1-2-3's) WYSIWYG module has little knowledge of what is going on in the primary program. . ."

***PC Week*, October 1990**

"While the division of labor is mostly logical, it makes [Lotus 1-2-3's] system feel like exactly what it is: a patchwork." ***PC Magazine*, December 1990**

Lotus users! Save $395 off Quattro Pro 2.0! If you own Lotus 1-2-3, you can upgrade to Quattro Pro 2.0 for only $99.95! This includes our 60-day, money-back guarantee. Order today! See your dealer or CALL NOW 1-800-331-0877

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BORLAND

Makers of Paradox,® Quattro® Pro, Turbo C++, Turbo Pascal® and Sidekick.®

CODE: MB34

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Improved

BRIEFS

WINDOWS

Sytron Corp. has announced *Sytos Plus for Windows* ($225; upgrades for $75), the latest version of its *Sytos Plus* file backup software. 508-898-0100.

MathType from Design Science ($249), formerly a Mac-only product, now brings point-and-click mathematical equation building to *Windows*. 213-433-0685.

***BeckerTools* 2.0** from Abacus Software ($129.95) now offers file packing of up to 80 percent; bootable formats; a physical media check; a binary editor; delete/undelete; and copy/move for groups of files or directories, all available from one active icon under *Windows*. 800-451-4319.

SPREADSHEETS

Lotus Development Corp. has announced its *DataLens Driver for Paradox Table* ($75; $20 for registered *1-2-3* 3.1 users), which allows users of *1-2-3*, Release 3.1 and *1-2-3/G* to access *Paradox* databases using *1-2-3* commands. 800-345-1043.

Sideways ($89.95), the *1-2-3* printing utility from Funk Software, which allows rotation of spreadsheets on dot matrix printers, now supports *1-2-3* 3.*x*. 617-497-6339.

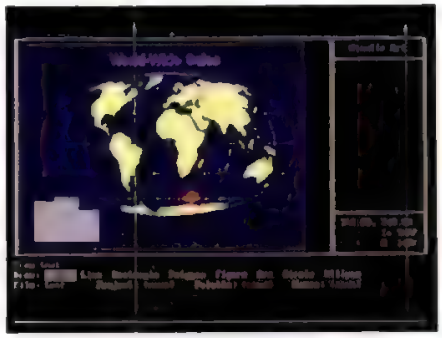
FAXES

Technology Concepts, makers of the voice/data switch Fax Line Manager, has created a new line of data/fax/voice mail/line sharing products. OmniLink ($249) offers fax and modem capability; OmniLink+ ($349) adds line sharing; OmniLink/V+ ($499) adds voice mail. All three products use a 2,400-bps modem with MNP5 or V.42 data compression and the FAX AT command set. 800-852-6881.

The Complete PC has added The Complete FAX/Gateway ($1,399) to its line of fax boards. The 9,600-bps fax board supports Novell's MHS e-mail system, comes with drivers for 130 different printers, and offers transmission scheduling and a host of other features. 408-434-1045.

Words, Graphs & Art Adds Preview Fonts And Drivers

IMPROVED ***Words, Graphs & Art*, Version 2.10—Kinetic Software**'s comprehensive presentation graphics package now includes preview-level fonts in the drawing module, enhanced printer drivers (for PostScript and HP compatibles, CalComp thermal, QMS ColorScript and many other printers), greater image resolution, and support for many new file formats.



***Words, Graphs & Art* now has preview level fonts in its drawing module.**

New LAN options in Version 2.10 include support for public, private, and subsidiary directories, as well as sysop control over development of user-specific commands. The new version also has the flexibility to suit a number of different LAN configurations and comes in separate server and node packages.
List Price: *Words, Graphs & Art*, Version 2.10, Single user or server package, $495; three nodes, $600; five nodes, $1,000. **Requires:** 640K, DOS 3.1 or later. Kinetic Software, 250 Distillery Commons, Louisville, KY 40206; 502-583-1679.

CIRCLE **443** ON READER SERVICE CARD

askSam: Global Approach to Data

IMPROVED ***askSam*, Version 5.0—askSam Systems'** free-form information management system, *askSam*, has 32 new commands and 10 enhanced functions, and also has new relational database features. The editor now allows free scrolling, and the hypertext interface has been significantly simplified.

New variable control allows global area sharing across files and programs. Data can be accessed, interchanged, compared, and manipulated regardless of program position.
List Price: *askSam*, Version 5.0, $395. **Requires:** 384K, DOS 3.1 or later. askSam Systems, P.O. Box 1428, Perry, FL 32347; 800-327-5726.

CIRCLE **444** ON READER SERVICE CARD

Norton Faster Backup

IMPROVED ***Norton Backup*, Version 1.2—**The mass backup portion of **Symantec Corp.**'s backup utility has been optimized for 386 systems, and now claims data throughput of up to 3.5 megabits per minute on these systems. It also offers a 25 percent increase in its restore speed, with simultaneous reading and writing of backed-up information. Other new features include improved error correction and handling, as well as better compatibility with a wider range of near-PC compatibles.
List Price: *Norton Backup*, Version 1.2, $149; upgrades $10. **Requires:** 512K. Symantec Corp., 10201 Torre Ave., Cupertino, CA 95014; 800-441-7234, 408-252-3570.

CIRCLE **445** ON READER SERVICE CARD

3-D Solid Modeling

IMPROVED ***SilverScreen*, Version 2.0—**A sweeping upgrade marks **Schroff Development Corp.**'s new version of its 3-D CAD and solid modeling package. A view-independent annotation feature adds angular, linear, diametric, and radial dimensioning, as well as bubbles, ANSI Y14.5 geometric , tolerance symbols, and external file notation links. Windowing overlay allows simultaneous saving of multiple drawing views.

File export formats now supported include .DXF, HPGL, IGES, .PCX, PostScript, and links to SMARTCAM and Stereolithography are also supported. The package also includes 2-D Boolean features and enhancements to its C compiler.
List Price: *SilverScreen*, Version 2.0, DOS package $995; *SilverScreen* Professional Edition for extended DOS, $3,300. **Requires:** 640K, math coprocessor. DOS 3.0 or later. Schroff Development Corp., P.O. Box 1334, Mission, KS 66222; 913-722-2826.

CIRCLE **447** ON READER SERVICE CARD

Better Billing

IMPROVED ***Timeslips III*, Version 4.0—**A new look, password protection, and enhanced billing and reporting capabilities are the major improvements in **Timeslips'** tracking, billing, and productivity software. New report modules include a user history, a client budget worksheet, a client hold sheet, and user-defined columnar reports with mail-merge capabilities. The billing module is now user-configurable. Two new data entry techniques have also been added. ■
List Price: *Timeslips III*, Version 4.0, $299.95; network version, $699.95. **Requires:** 384K, DOS 2.1 or later. Timeslips Corp., 239 Western Ave., Essex, MA 01929; 508-768-6100.

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"Swan's 486/25...a great machine at a near mythical price. If someone offers a similar configuration for less, worry about the quality."
—Computer Shopper, 10/90

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Drive Options	Mono	14" Flat Mono	VGA Mono	1024 VGA
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—PC Magazine, 12/25/90

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- High-resolution (720 x 348) mono video system

Complete 50MB Monochrome System

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Drive Options	Mono	14" Flat Mono	VGA Mono	1024 VGA
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386SX/16	VIDEO OPTIONS Include Monitor & Video Adapter			
Drive Options	Mono	14" Flat Mono	VGA Mono	1024 VGA
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w/100MB (17ms) IDE	$1645	$1695	$1845	$2045
w/200MB (16ms) IDE	$2145	$2195	$2345	$2545

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—Computer Buyer's Guide & Handbook

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PC MAGAZINE

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—Daniel Morgan, PC Magazine, 9/25/90

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This incredibly fast modem is ideal for high-volume, high-speed transmissions. Supports the v.42 standard for optimum error-free communication.

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2400 Bd Int/Ext	$79/$129
1200 Bd Int/Ext	$69/$89

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Store up to 500MB on a DC600XL cartridge with data compression. Features include data security, backup logging and full Novell, 3COM, and PCNET compatibility.

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This high-performance tape backup stores up to 250MB with data compression and features a 500KB/s data transfer rate. Supports the QIC-80 tape format.

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Swan 120MB Tape Backup

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Swan TECHNOLOGIES

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CIRCLE 268 ON READER SERVICE CARD

edited by
Matthew J. Ross

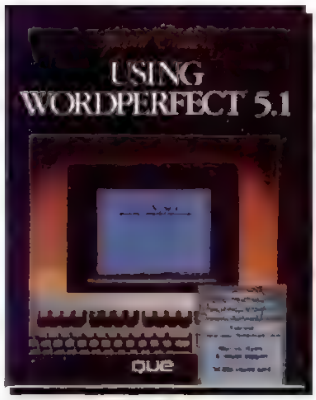
Read Only

Reviews of the Latest Books for the PC User

The Word on WordPerfect

A glance at the computer shelves of any well-stocked bookstore can be enough to convince you that as many words have been written *about WordPerfect* as have been written *with* it.

You can buy books on *WordPerfect* designed for every level of expertise. Some of these books are models of clarity and ingenuity. Some are inaccurate quickies designed to exploit an insatiable market for computer books, and some are encyclopedic studies written by a team of authors, because *WordPerfect* is now so vast and rich that no single author could possibly cover every aspect of the program.



With over 750,000 copies sold, *Using WordPerfect 5.1* remains the definitive resource for the popular word processor.

■ *Using WordPerfect 5.1 Special Edition*
Que Corp., $24.95.
The first and by far the most valuable of these encyclopedias is Que's *Using WordPerfect 5.1 Special Edition*, containing long essays by more than 20 specialists. Curiously, none of the authors is named on the title page; it says merely that the book was "Developed by Que Corporation." This indispensable volume takes you from the simplest first steps all the way to pages full of undocumented information that you need for advanced macro programming, with dozens of valuable examples along the way.
Que Corp., Carmel, IN 46032; 317-573-2583.
ISBN: 0-88022-554-8
CIRCLE 406 ON READER SERVICE CARD

Two more-recent titles deserve a place your shelf as well; their reviews follow below.

Additionally, a more-extensive survey of *WordPerfect* books will appear in a forthcoming issue of *PC Magazine* this spring.

■ *WordPerfect 5.1: The Complete Reference*
by Karen L. Acerson
Osborne McGraw-Hill, $24.95
If you'd ever managed the best-regarded customer support department in the industry, you would probably have a strong sense of what users need to know about a program and how they can learn it most effectively. Karen Acerson's experience at WordPerfect's toll-free support lines makes *WordPerfect 5.1: The Complete Reference* the book to keep on your desk when you need a quick, clear answer to a *WordPerfect* problem.

Her lucid presentation of a complex subject like *WordPerfect*'s equation editor is one example of the way her book enlightens you. She begins with the syntax used for equation-writing for the *WordPerfect* screen, follows it with the detailed vocabulary used within that syntax, and ends with guidelines for customized printing of equations.

Acerson devotes a thousand pages to an alphabetical list of commands and features. Unlike *WordPerfect*'s manual, which tends to be organized exclusively along the feature set and menus built into the program, the book also includes headings for features that you want to create on the page, like "Hanging Paragraphs and Indents," or general questions about files and programs supplied with the main program. Where the manual gives one way to accomplish something, Acerson typically offers two or three, and her alternative options can help you find easy ways out of some tight corners imposed by *WordPerfect*'s design.

Acerson's patient, step-by-step style wastes no words but never leaves out crucial details. If you're tempted to choose one of the rival books (that waste your time with high-octane chatterbox exclamations like "Nifty!"), don't do it. Get Acerson's book instead.
Osborne McGraw-Hill, Berkeley, CA 94710; 415-548-2805.
ISBN: 0 07-881634-3
CIRCLE 407 ON READER SERVICE CARD

■ *WordPerfect 5.1 Macros and Templates*
by Gordon McComb
Bantam Books, $39.95 (includes two disks).
WordPerfect's macro language, like the comparable macro language in *Microsoft Word*, gives a nontechnical user the personal control over a personal computer that only programmers used to have. A beginner can use macros simply to record and playback keystrokes for entering a return address or today's date. But if you're a curious beginner, the macro-editing features built into today's best word processors can tempt you to edit and modify your recorded keystrokes by adding prompts, keyboard input, and other options.

Gordon McComb's *WordPerfect 5.1 Macros and Templates* is by far the most thorough and helpful guide to programming in *WordPerfect*'s macro language. McComb moves quickly past the basics to such surprisingly easy features as prompts and user-created menus, and then on to real-world macro applications like legal boilerplate, invoices, label printing, and desktop publishing layouts.

By the time you've worked your way through a few of the

book's examples, you're ready for advanced topics like macros that help you edit other macros, and even macros that create other macros using elements you enter when prompted. The book also offers essential tips for debugging macros and creating *WordPerfect* macros using languages like BASIC.

The two 360K disks that come with the book are packed with standalone macros and an extensive letter-writing system, all thoroughly explained in the text. They also include utilities for printing and diagnosing macros. The only potential problem you may have with McComb's book is that it may tempt you to spend your time writing macros, not words.
—Edward Mendelson ■
Bantam Books, New York, NY 10103; 212-765-6500.
ISBN 0-553-34875-2
CIRCLE 408 ON READER SERVICE CARD

Decisions, decisions. Should you choose PCs based on stand-alone performance or network potential? Compatibility with today's standards or adaptability for the future? Power or price? Form or function?

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by Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

Pen Windows, an Interface That Reads Handwriting, Due This Year from Microsoft

Not wanting to be outdone by Go Corp.'s announcement of a handwriting-recognition operating system, Microsoft has started to show privately its own pen interface for *Windows*.

The basic work on the software is just about completed and Microsoft plans to incorporate the code in the next version of *Windows*, due midyear.

Applications that can accept handwriting from a pen will probably follow six months later; the program interface will remain dormant within millions of copies of *Windows* 3.1 until the applications are ready.

Unlike Go Corp. and Slate, which are building solutions primarily for people who are not regular PC users, Microsoft is aiming squarely at the office worker who wants to scribble a few numbers into a spreadsheet or dial into CompuServe without ever touching a keyboard.

A standard digitizing tablet and pen is all that will be needed under *Windows* 3.1, and the pen will work cooperatively with the mouse. You'll be able to select a menu choice with either device and then start writing when you've opened a window that accepts handwritten input.

The initial software is likely to be a utility that translates handwriting and lets you copy the converted text to the Clipboard for insertion into an application.

In time, many *Windows* applications will add the ability to accept handwriting directly, and eventually programs will be designed to make the most of the pen.

Supporters of Go's software maintain that it's impossible to do an efficient job of translating handwriting without an operating system designed specifically for that task. In its demonstrations, the *Windows* translation seemed every bit as agile at understanding handwriting as Go's system, but there's no way of telling which system will be better in average use until commercial products are on the market and can be tested.

Microsoft is aiming squarely at the office worker who wants to scribble a few numbers into a spreadsheet.

Prometheus Admits That It Infringed Hayes' Patent

One of the five modem manufacturers that Hayes Microcomputer Products was suing over patent infringement conceded the issue on the eve of the trial.

According to Hayes, Prometheus agreed to sign a statement admitting that its modems infringed on a 1985 Hayes patent that defines the timing and escape sequence a modem uses to switch between the AT command mode and data transfer mode.

Prometheus will begin to pay royalties to Hayes for use of the technology.

Hayes' suit against Ven-Tel, Omnitel, and Everex went to trial in early January.

Disney Is Getting Serious About Software

The Walt Disney Co.'s entry into software is turning out to be every

CONTINUES ON PAGE 69

If you think the LaserPrinter E looks good in person,

wait till you see how it looks on paper.

	The IBM LaserPrinter E	HP LaserJet IIP
Speed	✓ up to 5 ppm	up to 4 ppm
Speed upgrade option	✓ up to 10 ppm	No
Adobe PostScript option	Yes	Yes
Printer emulation	✓ IBM, HP PCL	HP PCL
Std. plotter emulation	✓ Yes	No
Font card slots	✓ 2	1
Std. input paper tray capacity	✓ 200	50
Std. output paper tray capacity	✓ 100	50
Opt. sec. input paper tray capacity	✓ 500	250
Opt. envelope tray capacity	✓ 75	20
Mfr. suggested retail price	✓ $1495	$1495

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Pipeline

CONTINUED FROM PAGE 67

bit as successful as its other ventures.

In 1988, Disney licensed *Who Framed Roger Rabbit*; when the game sold over 100,000 copies, the company created a separate division to develop and market programs. In its first year with products on the market, Walt Disney Software is already well established.

Disney has done more than simply sell programs, it has established a new platform for adding audio to PC software with the Sound Source.

This past holiday season, Disney's combination of the Sound Source and several programs starring Mickey Mouse was a runaway hit.

Disney seems to understand the open-platform principles that have made most other PC venturs successful: Its encouraging other software developers to write programs that exercise the Sound Source.

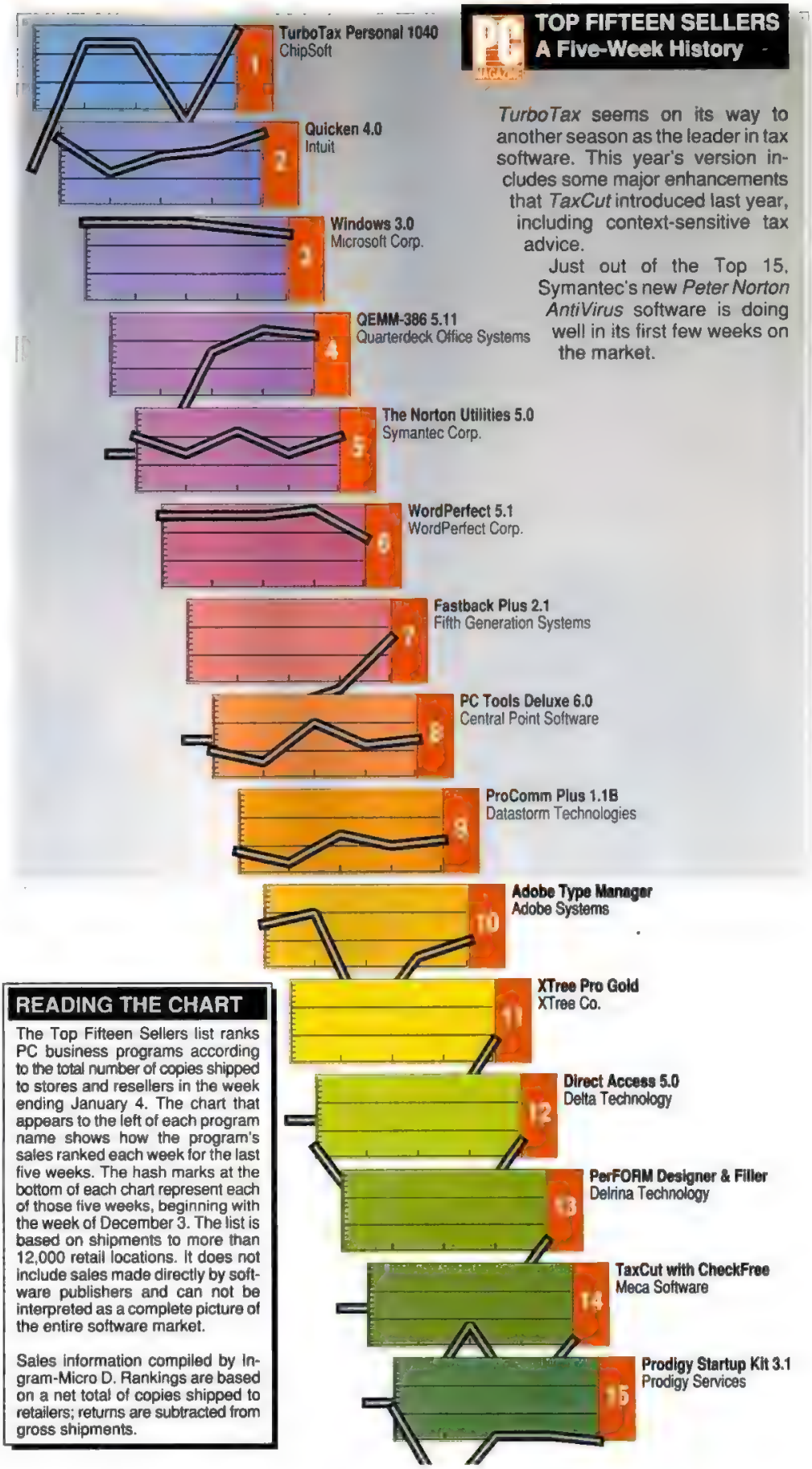
The company is now planning a regular series of programs, most of them tied into Disney characters and successful movie titles. For example, this spring, Disney will release PC games based on the films *Arachnophobia* and *Dick Tracy*.

Once Disney's operation is running at full tilt, you'll see software releases tied to the premiere of new films.

If the quality of these educational games stays at the same high level achieved by the current Mickey Mouse series, Walt Disney Co. is likely to become the dominant publisher of children's software.

That market may not be as easy to hold onto as Disney hopes. Another company is about to enter the field. Sony has announced that it is opening a software unit which will be in the same corporate group as Columbia Entertainment.

While Sony has not yet made its intentions known in software, Columbia has changed its longstanding policy of encouraging individual software publishers to develop programs that were based on Columbia films. ■



READING THE CHART

The Top Fifteen Sellers list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending January 4. The chart that appears to the left of each program name shows how the program's sales ranked each week for the last five weeks. The hash marks at the bottom of each chart represent each of those five weeks, beginning with the week of December 3. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a complete picture of the entire software market.

Sales information compiled by Ingram-Micro D. Rankings are based on a net total of copies shipped to retailers; returns are subtracted from gross shipments.

THE T
LAP
MASS

PC WEEK POLL: 386SX-BASED LAPTOP/PORTABLE COMPUTERS

	Overall Weighted Score	Standard Software Compat.	Display Quality	Overall Reliability	Overall Performance	Keyboard Quality	Product Support Quality	Repair Service Availability	Value Relative To Cost	Overall Functionality As Compared To Desktop PCs	Board-Level Hardware Compat.	Product Support Access	Quality of Document
Dell System® 316LT	1st	1st	2nd	1st	1st	1st	1st	1st	1st	1st	1st	1st	1st
Toshiba T3100SX	2nd	2nd	1st	2nd	2nd	2nd	3rd	2nd	2nd	2nd	2nd	2nd	2nd
Zenith SuperaPort SX Model 40	3rd	3rd	3rd	3rd	3rd	3rd	2nd	3rd	3rd	3rd	3rd	3rd	3rd

It wasn't very pretty.

Last July, a computer company from Austin, Texas annihilated the competition in the *PC Week* Corporate Satisfaction Poll for 386™ SX based laptops.

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Bill Machrone

Au Revoir, OS/2

Don't say goodbye to OS/2. Say, "see ya later."

The people have spoken. They just don't want OS/2 on their desktops. They want a multitasking operating environment with a graphical user interface, and it's called *Windows* 3.0. Are they getting a good environment? Yes. Is it the best one? Probably not.

OS/2 offers significant advantages unmatched by *Windows*, such as multithreading within applications, a high-performance file system, rich interprocess communications, and a powerful application program interface for graphics. Of course, it lacked a few niceties, such as printer drivers. Now OS/2 has been remanded to IBM for continuing development, although with cross-licenses to give Microsoft and IBM access to one another's best ideas. *Windows* has thoroughly captured the popular imagination, and has the full attention of software developers.

This success could have belonged to OS/2. It was positioned to take over the world, but somehow it didn't. With the wisdom of hindsight, we know all the things Microsoft and IBM did wrong with the rollout and subsequent marketing of OS/2.

They were in too much of a hurry. The French call it, "skinning the bear before he is on the ground." OS/2 could have spent another year in the oven and been far better off for it.

They called it OS/2 instead of calling it DOS 5. In so doing, they positioned OS/2 as a discontinuity in the dynastic succession of DOS versions. They posited two classes of machines, two classes of applications, and two of users. The supposed DOS underclass, however, had all the applications and it didn't cost a penny extra.

Sure, it would have been tough explaining why the operating system calls were different, but as long as there was a robust compatibility box to handle existing DOS apps, everything would have been all right. Wrapping the changes around the adoption of a graphical user interface would have eased the pain.

They built it around the 286 instead of the 386. Everybody knew that the 286 was brain damaged. The intelligent thing would have been to expedite a quick and orderly progression to the 386, rather than the misguided attempt to keep the installed base of PC ATs alive. Virtual 8086 mode turned out not to be the piece of cake everyone expected, making the DOS compatibility box (often referred to as the penalty box) a near impossibility with 286-based hardware, while the 386 was designed with this capability in mind.

Intel was a factor, too. By deciding not to let another manufacturer second-source the 386, they kept 386 prices high and spurred AMD and Harris to produce faster versions of the 286. These faster chips unnaturally extended the 286's lifetime and further bloated the installed base of 286 machines.

IBM spent millions trying to tie it to the PS/2. Seeking uniqueness and competitive advantages, IBM trained its sales and support staffs to tout OS/2 and PS/2s as the winning combination in corporate desktop computing. In so doing, IBM alienated those smart enough to know that the hardware and software had nothing to do with one another. They also confused the rest of the market, which, instead of running for PS/2s, shunned OS/2.

They charged too much for the software

ILLUSTRATION, JOHN LABBE

developer's kit. The cost of entry for DOS developers is a few hundred dollars for a compiler and a couple of books. The OS/2 SDK cost $3,000. Apologized a Microsoft official, "We'd never made money from the developers before." Granted, the OS/2 SDK needs a few able-bodied people to move it from place to place. There's so much paper and so many disks that they probably never made a dime on it. But the barrier was high and it

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Bill Machrone

created a bad attitude, even for those who chose to leap it. Eventually Microsoft had to introduce a "lite" version of the SDK, leaving much of the useless documentation and half of the price behind.

Microsoft wasn't there with the applications. Neither was anybody else. If OS/2 had been introduced with a full suite of application programs (word processor, spreadsheet, database, graphics, communications), it would have gone down a lot easier. Instead, OS/2 was introduced without any and then reintroduced with applications. When Microsoft finally got around to releasing a version of *Microsoft Excel* for OS/2, it ignored all of OS/2's advantages and gave us a literal, single-threaded translation.

Contrast this with Aldus, which in its version of *PageMaker* for OS/2, took full advantage of multithreaded execution. The results speak for themselves. You almost never see the "wait" hourglass as you pour text, resize graphics, print, and perform other time-consuming processes. The OS/2 version can't make the finished pages come out of the printer any faster, but you get more done because you can overlap all the interim steps. By contrast, the *Excel* implementation might charitably be called expedient.

CONVERGING PATHS

The sudden popularity and hundreds of applications for *Windows* 3.0 has put a major crimp in OS/2's progress. The previously announced Binary Compatibility Layer (BCL) would have allowed *Windows* and Presentation Manager applications to coexist in OS/2.

Now Microsoft is backpedaling from the BCL, claiming that they don't want to be responsible (read: blamed) for poorly written *Windows* applications that might not operate correctly under OS/2. This latest move has led to speculation that Presentation Manager's days are numbered, and that the *Windows* API will simply be moved to OS/2. Such a marriage of OS/2 and *Windows* would be an effective way to migrate *Windows* applications to OS/2 without the overhead of supporting two APIs.

OS/2 may not have set the world on fire, but one way or another, it's still the future. You can't keep a good technology down. ■

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John C. Dvorak

The "Intuitive" Computing Myth

The only reason why certain computers and software packages are considered intuitive is marketing hype.

Often, when writing about computers or talking about software, we discuss the notion of intuition. We say that this or that package or machine is "intuitive" or isn't "intuitive." This aspect of computing, of course, seems only to be based on the prejudices and tastes of the individual writer—something never discussed.

Take the Macintosh (please!). Here's a machine that has become the epitome of what is "intuitive" according to all the observers. How did this happen? This was largely accomplished by a folklore created around the machine and its mythological ease of use. Sure, the Mac is easy to use—once someone shows you how! After you are shown the ropes, it mysteriously becomes intuitive. Put a pure novice in front of a Mac, say nothing, and watch what happens.

What happens *is* nothing. The mouse makes no sense. I've never seen anyone figure out the double-click mouse launch sequence without being told about it. In short, like everything else, it has to be taught. Sure, once you learn the rudiments of a graphical interface like the Mac or *Windows*, it is a bit easier to learn the rudiments of X-Windows, the Amiga, or whatever. Even so, you can only get so far without a book or an instructor. I could never figure out file management on the Amiga, for example, despite the fact that it's a GUI like *Windows*.

Let's face it—there is no such thing as "intuitive" computing. Someone habituated to the *WordStar* diamond for cursor control finds anything that uses the diamond intuitive. Someone accustomed to the screwy *WordPerfect* function key usage would find anything using the same function keys intuitive, while guys like me call the same program "screwy." Who is right? Neither of us, because there is no standard for intuition.

There will never be a standard for what is intuitive. "Intuition" is more like fashion than like mathematics. It can almost be likened to a fad—likened to changing taste.

CULTURE AND INTUITION

Intuition is like beauty, culture bound. I'm reminded of the lanky 7-foot 6-inch basketball player Manute Bol, who as a Sudanese child had his front teeth chiseled off because the Sudanese believed that it made men "more handsome." The cultural aspects of subjective taste regarding beauty are frightening when examined from the perspective of a cultural anthropologist. Sometimes you wonder about your friends when they cite some horrible-looking person as beautiful or handsome. Elizabeth Taylor said she liked Richard Burton because she was attracted to men with pock-marked faces. We are all subject to anomalies in our likes and dislikes. Because of this there is no universal beauty any more than there is a universal intuition. We are fooling ourselves if we think otherwise.

So what is the point of the graphical user interface and the never-ending demand for intuitive computing? It's a marketing crock, that's what it is. We should never forget this, since such nonsense prevents innovation and new ways of approaching how we communicate with these machines. One reason why *Wang Freestyle*—an amazing interface—is never discussed is that the marketers have convinced us *Freestyle* isn't an intuitive standard. Somehow we've been suckered.

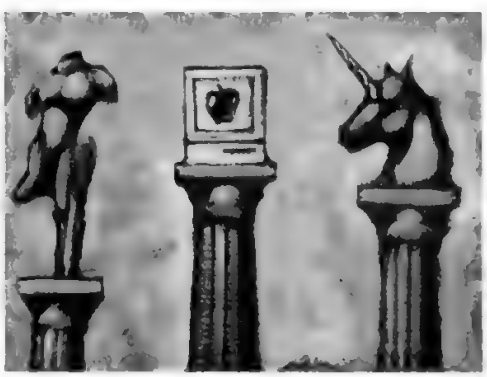

ILLUSTRATION: JOHN LABBE

Let's rid ourselves of the intuitive concept. Just look at the automobile and all the time it has had to evolve. Cars aren't intuitive in any way; that idea was dropped a long time back. You have to be taught how to drive one. There are a few good standards and that's about it. It's all we can expect from computers: a few good standards.

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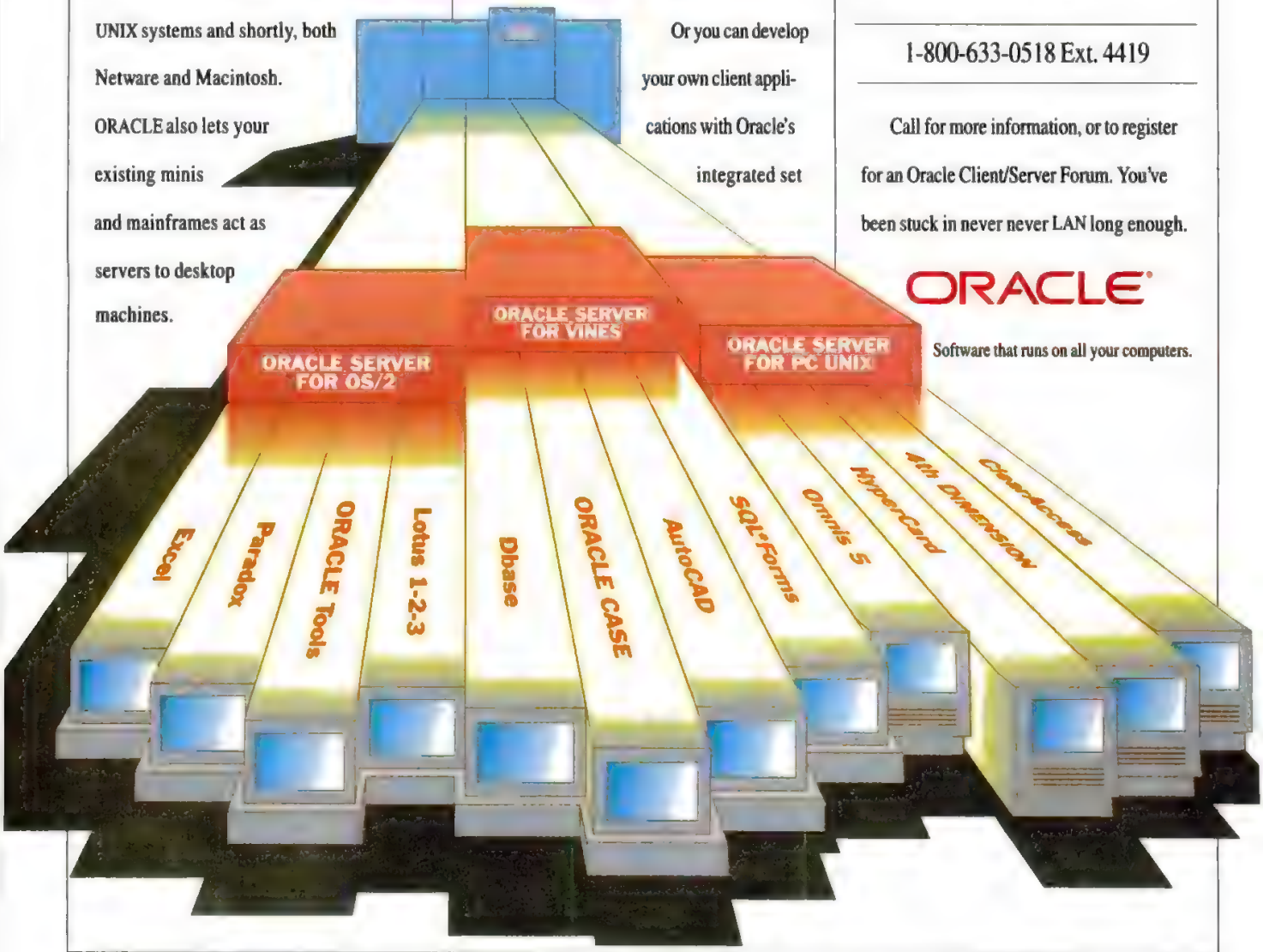

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John C.
Dvorak

Inside Track

Worst Kept Secret of the Month Dept.: With AMD about to roll out its version of the 386 chip, Intel is going to up the ante by releasing a new **cheap version of the 486.** In fact, Intel may de-emphasize the 386 the way it once did the 286.

The new 486 chip, which for the purposes of this article I'm going to call the 486SX, will be a **20-MHz 486** without the built-in math coprocessor. It will sell for about $250 right out of the chute. Its **price** is expected to **drop rapidly.** Compare that to $750 for a 25-MHz 486 or $950 for a 33-MHz real 486. $250 is about the price people are paying for a 33-MHz 386 today.

The company will probably roll out this 486 chip in the third quarter along with a **50-MHz real 486,** which may also be low-balled.

Some Asides Dept.: A 20-MHz 486 with its built-in cache should be able to **perform** as well as the 33-MHz 386 and not require as many **expensive components** to manufacture a system. The math coprocessor isn't needed for most applications. So if the chips are priced about the same, a machine wrapped around the 486SX should be much **cheaper to make and sell.**

Intel assumes that AMD won't be giving away its 386 chip until it recoups its R&D investment. AMD hopes to counter this move by bringing out a **40-MHz version of its 386** that will take all the high-end business away from the Intel 386 and outperform a 25-MHz 486. Within a few years, though, we can expect to see the same price erosion with the 386 that took place with the 286. **A 12-MHz 286 can be had today for $7.** As a huckster might say, "They're giving them away!"

So we can expect the same to happen to the 386. Intel hopes it can **move upscale to the 586** and beyond before all this happens.

The irony in all this is that the basic architectural change that took place with the invention of the 386 remains inherent in all the future Intel chips. While more functionality is encapsulated on the silicon with each new reiteration, the instruction set remains a 386 instruction set. So there is no way Intel can **trash the 386 clone chips** the way it did the "brain-dead" 286. People who buy the **el cheapo 386** of the future will be in the same ball game as someone running a future 786 machine. While the 386 will seem like slow-pitch, it will still be baseball.

In this market, sales and development will begin to **gravitate** toward the low-end cheap machines, since most people buy on price, not performance. This should create a **peculiar stagnation** in a performance growth curve that should be accelerating. This phenomenon might offer an opportunity for a new processor architecture to emerge.

Intel is looking to roll out a low-cost 20-MHz 486, minus the math coprocessor, and a full-fledged 50-MHz 486 chip in the third quarter.

Intel is also in the unfortunate situation of having achieved too much success for any anti-386 ploy to work successfully. The company has been telling vendors that in 1991 it will produce and ship over **10 million 386SX chips alone!** AMD will roll out a 386SX and observers say it will be able to hit 25 MHz. One company told me that it expects to produce a 25-MHz 386SX for under $1,000 sometime in 1991. This could be **the final blow** to the 8088 and 80286 that the experts have been predicting for the last five years. I suspect, though, that a **superfast 8088 box selling for $199** might be viable in the years ahead.

To further **complicate matters,** Sony Corp. is trying to pester AMD into selling the company, but the worried U.S. government will step in and **prevent a sale to Sony.** Meanwhile, groups are forming in Silicon Valley that are prepared to buy AMD.

If 1991 benchmarks the upcoming decade, it's going to be **quite a ride** for this business. Hang on!

Save Some Money Dept.: As many of you know, IQ Engineering **invented the third-party add-in HP LaserJet font cartridge.** The owner of the company used to work for Hewlett-Packard, in fact. The company has announced a couple of new offerings—the DJ Plus and DJ/500 cartridges for HP DeskJet printers. The standard edition has **100 fonts** from 3 to 24 points, the Professional edition adds some additional "Helv" and "TmsRmn" sizes. The cartridges cost $149. Tell them you read this in Inside Track and they'll **take $50 off the price** of either cartridge. **What a deal!**

In addition, the company has a new $599 PostScript cartridge for the LaserJets that it's about to upgrade with additional fonts. The $100 upgrade will be **free** to Inside Track readers. (I do my part.) Check this out by contacting IQ Engineering, 685 N. Pastoria Ave., Sunnyvale, CA 94086; 800-765-FONT, 408-733-1161.

Genuinely Interesting Software Dept.: From Synectechs in Natick, Mass., comes **Slowdown**—the ultimate speed utility. Here's a TSR that enables you to slow your machine to almost a dead stop in increments of 1/1,000. I'm told that the utility has three major uses: 1) To run old PC games that have no clock compensation. 2) For debugging. 3) **To cheat at Tetris.** It allows me to see those animations that **zoom** by the screen on my 486. Call 508-655-5430 for a copy. It's priced at $39.95, but tell them you read about it in Inside Track and get it for $29.95, **another good deal.** ■

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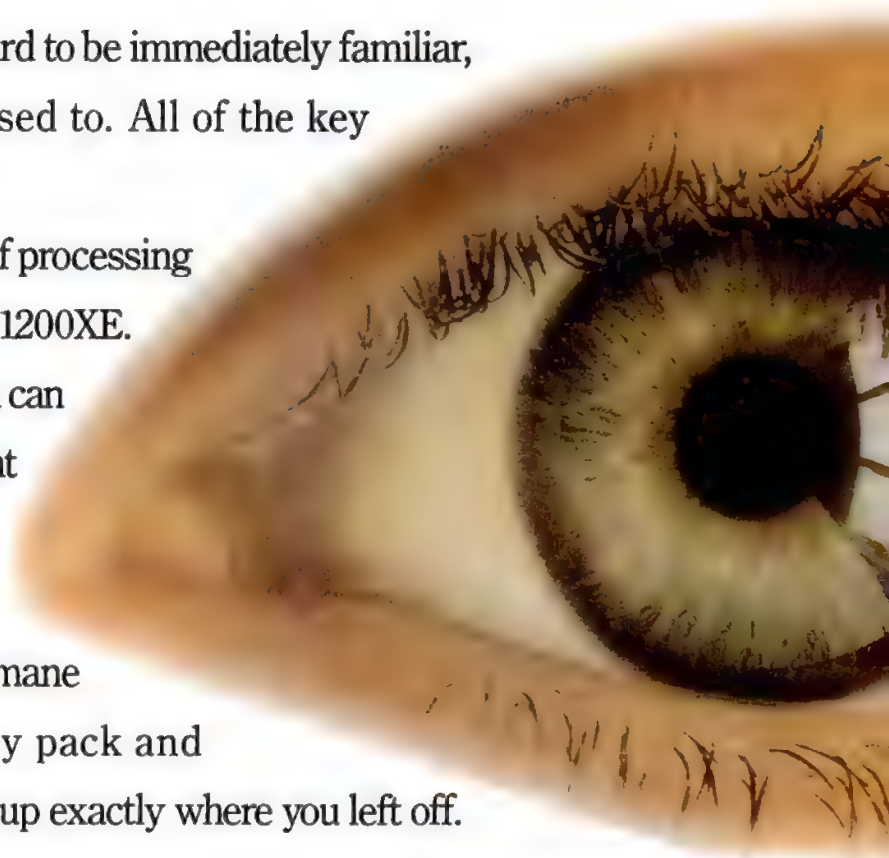
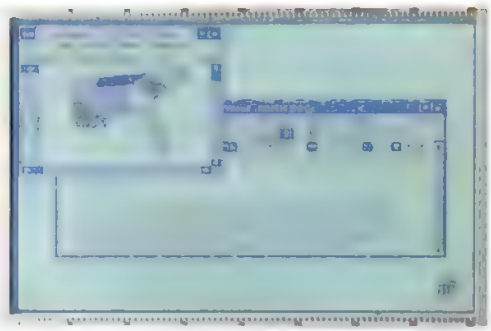


Plus, you'll undoubtedly appreciate the T1200XE's other humane features like a slim line battery pack and AutoResume,™ which lets you pick up exactly where you left off. No grand reopening of the system, program and file every time you want to start work again.

The only thing you'll notice we've skimped on is size and weight. After all, what good is a portable if you can't take it with you?



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CIRCLE 732 ON READER SERVICE CARD

Jim Seymour

What's the Right PC For Today?

Finding the right PC means more than purchasing the right amount of processing power for the work at hand. Little touches matter, too.

Are you happy with the PC on your desk? Is it powerful enough? Is it convenient? Are the ergonomics of the design reasonably good? If not—and most of us answer "no" to at least a couple of those questions—what would you change?

What, in fact, do you think constitutes an appropriate general-purpose office-PC standard today?

I've been wrestling with this one for several months. A number of large corporate clients have been reevaluating their PC-buying guidelines, and I've been working with their Information Center staffs and MIS people to determine what kind of machines they should buy in the 1991 capital-acquisitions cycle.

Nearly all of them have stopped buying 286 PCs. That was close to a no-brainer. But among 386SXs, 386DXs, and 486s, it's hard to settle on a machine that is right today, and will still be right over the next three years—the IRS depreciation period for personal computers.

Settling on the right microprocessor is obviously a key issue here, though hardly the *only* issue. Almost always, my recommendation has been to buy 386SXs.

LIVING WITH AN SX

Last fall I set aside the high-end PCs I usually work with, and for one month did all my work on a 16-MHz 386SX PC. The notion to limit myself to an SX box for awhile grew out of a sense that I should taste the medicine I prescribe for others. I'd also gotten a few notes from readers who worried that those of us who write for PC magazines always work with the latest, fanciest, and most-powerful systems, and thus lose touch with what the Common Man must use.

I don't accept that thesis (you should see the variety of PCs on the desks around here, not all of them powerhouses, by any means), but since I really do think SX machines are a good choice for many users' needs, I also wasn't much worried about the consequences of using one in my office for awhile.

As I later wrote in a column, I noticed little difference in my daily routine during that time. Sure, some things weren't so snappy. And in graphical applications I noticed a slowdown. But there was no sag in my productivity, and I never felt burdened by the SX's performance.

If I'd been doing nothing but CAD work or desktop publishing, I'd have felt differently, of course. But I've never suggested an SX box as a dedicated graphics workstation. (And I wasn't running *Windows* all the time; if I had been, I'd have noticed a much bigger sag in performance. I think that a 20-MHz 386SX should be the low end for *Windows* users.)

That month I spent using a 386SX persuaded me that I'd been right: SXs are a good standard platform for most corporate users.

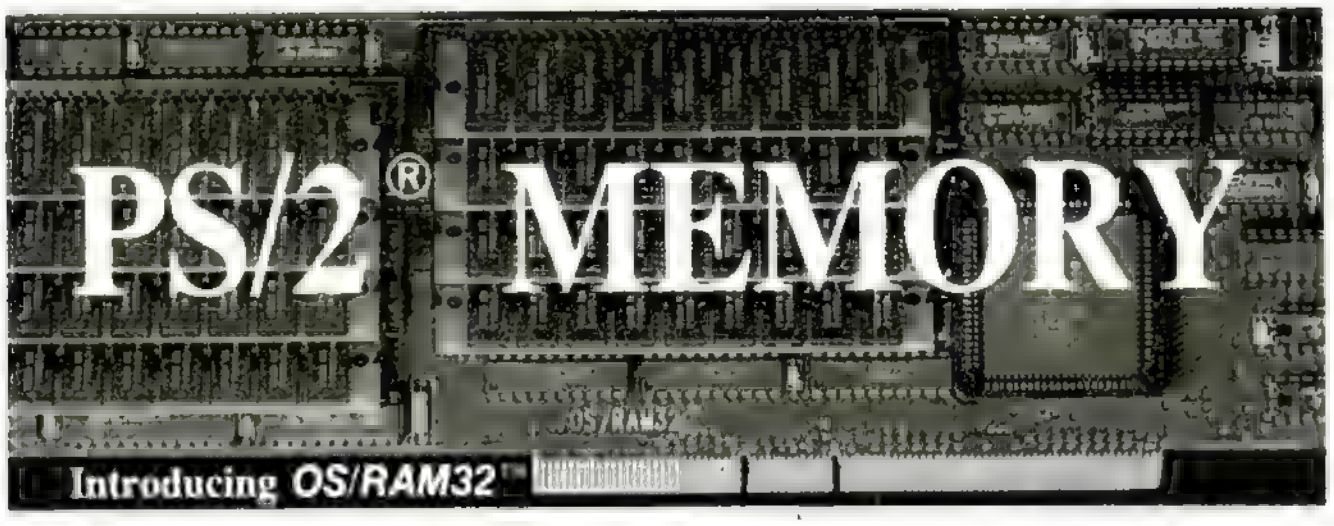
But there are other issues, beyond choosing the right processor. And that immersion in SX technology got me thinking about those other issues, as well.

I've long been a fan of small-footprint PCs, for example. Lately, I've also admired the low-profile "pizza box" chassis available from some vendors. But while my affection for small footprint machines—what some call

ILLUSTRATION JOHN LABBE

"shadow of the monitor" chassis, since they're about the size of the monitor itself—has grown, the attraction of low-profile boxes has faded.

Zeos Chairman and CEO Greg Herrick has a wonderful line about low-profile PCs: "They're only an issue if you have problems with low-flying planes in your office." Because in almost every way, a low-profile chassis represents unfortunate compromises: the number and orientation of expansion slots and



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Computers emit radio signals in their operation. Because these signals may cause interference to radio and television reception, the marketing and the use of computers is regulated by the Federal Communications Commission. Under federal rules, computer users are responsible for remedying interference, including interference in neighboring homes.

Computers certified by the FCC as meeting the Class B standard are less likely to cause interference to radio and TV reception than those that have been verified by the manufacturer or importer to the Class A standards. Only Class B certified computers may be advertised, sold, or leased for use in residences. A similar regulatory program applies in Canada.

Buyers seeking computers for use in homes (including offices at home) should shop for computers and peripherals which have been Class B certified. These devices carry a label with an FCC ID number. Both new and used Class A verified devices may be sold only for use in commercial and industrial locations. Signals from computers are more likely to be masked by electrical noise from other equipment in such an environment. These areas are also likely to have fewer radios and TVs. Accordingly, equipment marketed only for use in these locations may meet the less rigorous Class A standard. Class B certified equipment may be marketed for use in residences as well as commercial and industrial locations.

As you shop for a computer for use in your home, look for the FCC classification in the specifications or ask your vendor to recommend only machines that have been certified to the Class B limits. TV viewers and radio listeners in your home and in neighboring homes will be glad you did.

Jim Seymour

drive bays, cooling efficiency, easy access to components, and on and on.

The one advantage of a low-profile chassis I'll grant is aesthetic: low-profile boxes look good. But both aesthetics and functionality are even better served by relocating that system box on a nearby bookshelf, or even under the desk. Anywhere but on your desk. (Small-footprint system units make that even easier.) All you want on the work surface are the monitor, the keyboard, and maybe a pointing device, such as a mouse or trackball.

TRACKBALLS, MICE, AND WORKSPACE

Speaking of pointing devices, my experience working with that SX box—which was set up in a limited workspace typical of most open-plan-office cubicles—confirmed my long-time bias for trackballs. Not only did all the usual trackball advantages come through clearly—comfort, better accuracy, a more natural motion—but the space-saving aspects were evident, too. With the trackball fixed in one place—at the end of the keyboard—I didn't have to worry about keeping an area clear for a mouse to move back and forth.

A small keyboard helps, too. Most of us rarely use a numeric keypad; a narrower keyboard without one saves space. My favorite small keyboard is the one with the PS/2 Model 25; Zeos offers a good small-footprint keyboard, too.

What do you do with that keyboard when you need a little extra workspace in front of you...to sign a letter or a check, or just to get it out of the way when you're not using it? The best answer I've seen yet is an obscure accessory that Compaq used to sell, their "Desksaver" shelf. The Desksaver was a shallow, broad, wedge-like shelf that sat atop your desk. Your monitor sat on the shelf, and there was just enough room underneath to slide your keyboard when you're not using it. I've looked for years for one of those under-the-counter keyboard drawers sturdy enough to stand up to daily use, without luck.

I've got a lot more ideas about making more civilized workstations; next time I'll expand on this list. If you have suggestions, send them addressed to me at *PC Magazine*, One Park Ave., New York, NY 10016. Together maybe we can persuade the PC industry to turn out systems better suited to our needs. ■

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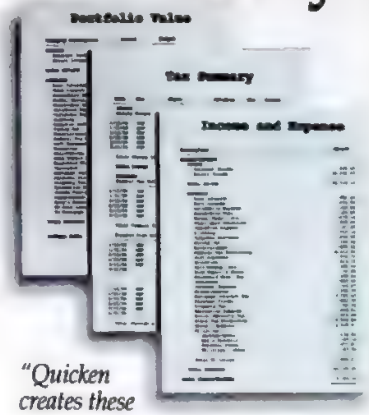

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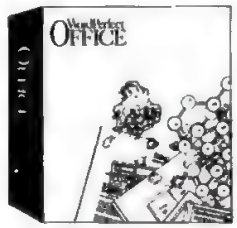

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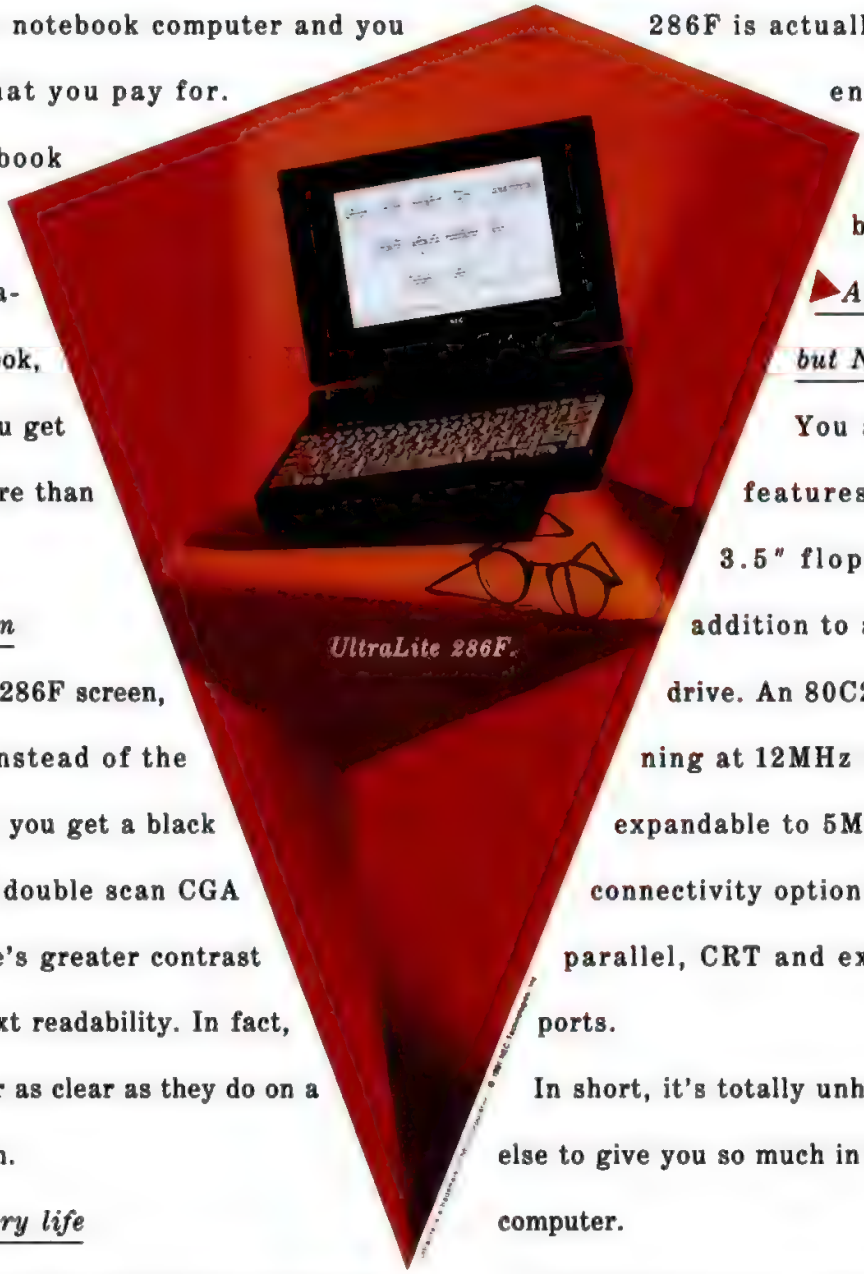

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A Case of Computer Design

The trend in personal computer design is smaller boxes with greater integration and lower cost. But is this what today's business user really needs?

It is hardly the burning issue of the day. It is not the subject of debate among prestigious panels of industry experts at trade shows. For most people, it probably seems no more important than whether soft-boiled eggs ought to be eaten from the big end or the little end, and whether a roll of toilet paper should have the loose end toward or away from the wall.

Nevertheless, this question is a topic of considerable importance, figuring significantly in personal computer vendors' plans. It has potential economic consequences for users that are much greater than is generally recognized. I refer to the matter of big boxes versus little boxes: Whether personal computers are best when built in large cases with big power supplies and lots of expansion slots, or in small, compact formats with few or no slots and all the functions that you need packaged right on the systemboard.

Despite the popularity of the Apple II, the TRS-80, and other personal computers in the late 1970s, it was the introduction of the IBM PC in 1981 that led to the personal computer's widespread acceptance in business. Built in a large, sturdy metal case, the IBM PC set the precedent for mainstream personal computers in business for most of the 1980s. The IBM PC AT—introduced in 1984—brought with it an even bigger case, more slots, and a larger power supply.

Even the introduction of the IBM PS/2 line in 1987 left the big box syndrome largely intact. True, the PS/2 Model 50 was a harbinger of the "smaller is better" movement, but the original PS/2 Models 60 and 80 were still squarely in the big box camp.

Over the past few years, however, the new direction taken with the Model 50 has gathered momentum. The small box movement has met a ready acceptance and has gained market share at the expense of big boxes.

Closely related to that gain, of course, has been the growing presence of portable systems. These, quite naturally, fall into the small-box camp, since not only small size but light weight are the most-desirable qualities in portable systems.

In fact, portable systems have been the real champions of the small box alternative for some time. Both the old Osborne 1 and the original Compaq Portable—though large by contemporary standards—were much smaller than the desktop systems of the early 1980s.

Today, between the small footprint desktops on the one hand, and ever-smaller portable systems on the other, it would be easy to get the impression that big boxes are an obsolete relic of the past. In fact, in recent conversations with executives of some major computer vendors, I've found quite a few who clearly believe that to be so.

Proponents of the small box argue that there is no longer any reason for large boxes except for special applications like dedicated network servers and maybe a few high-end desktop systems. They are basing their product strategy on the assumption that there is no longer any reason for big boxes on the individual office desktop.

. . . IN SMALL PACKAGES

These small box proponents' arguments are

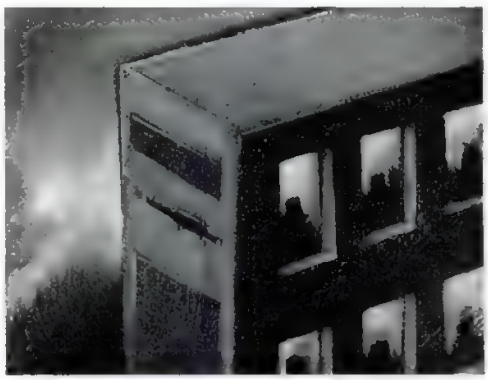

ILLUSTRATION JOHN LABBE

many and plausible. First of all, they make the very valid point that all desks are of finite size and never big enough. Compact "pizza box" personal computers with integrated components are more desirable since they occupy less precious and scarce desktop real estate.

Second, they point out that improving technology allows for integration of key functions. Highly integrated circuits and surface-mount technology make it possible to incorporate

disk and display controllers directly onto the systemboard in a small format. Widespread acceptance of 3.5-inch floppy and hard disk drives, too, makes small boxes possible.

Third, all this helps to bring down the cost of systems. Smaller cases, smaller power supplies, and fewer expansion slots add up to lower manufacturing costs.

Finally many (though not all) argue that increasingly small portable systems will replace desktop systems altogether. More and more users will simply use their portable as their desktop system, as well. Since portables are naturally small-format systems, that will further the cause of small boxes against the large.

In the face of such compelling arguments, it would seem that large boxes are surely doomed. After all, who needs to pay more for a big clunky system that takes more room and does nothing a smaller, less-expensive one can't do better? Can there be any future for big boxes?

You bet there can be! Beware of all this little box propaganda! There's more to the story than the advocates of the little box are telling.

BIGGER IS BETTER

Small boxes do not really minimize the amount of consumed desktop real estate as much as is claimed, either absolutely or even relative to large-format systems. After all, large-format systems alongside the desk can actually require *less* space on the desk than their smaller competitors.

Second, while it is certainly true that technology makes it possible to cram more function into a smaller box, it does not thereby follow that it makes a large format with plenty of expansion slots obsolete. Third, and closely related to this, while it is certainly true that integrating functions can lower the initial cost of the system, that does not mean the overall cost of owning the system will be diminished.

The incorrect assumption hidden in both of these arguments is that technology has stabilized sufficiently to make a particular set of integrated functions adequate for the life of a system. The reality is that continued change in technology is a powerful argument for the modularity and expansibility that a large-format system provides.

The small-format "pizza box" system may have a lower initial price, but it will be an obsolete relic with outdated technology long before the large system with its big power supply and abundance of expansion slots. The latter can be upgraded to keep current with advances in display and disk controllers, new peripherals like optical disks, larger-format disks, new input devices, and the like. Many newer large-format systems even put the microprocessor on an expansion board so that it, too, can be upgraded.

Small-format systems, like portable computers, certainly have their advantages. It is not my intention to suggest that they are of no value. Big boxes, however, continue to be a much-better investment for many if not most users. The prudent buyer should be wary of the false economies that lurk in small boxes which lack the room to expand and change as technology continues to improve. ■

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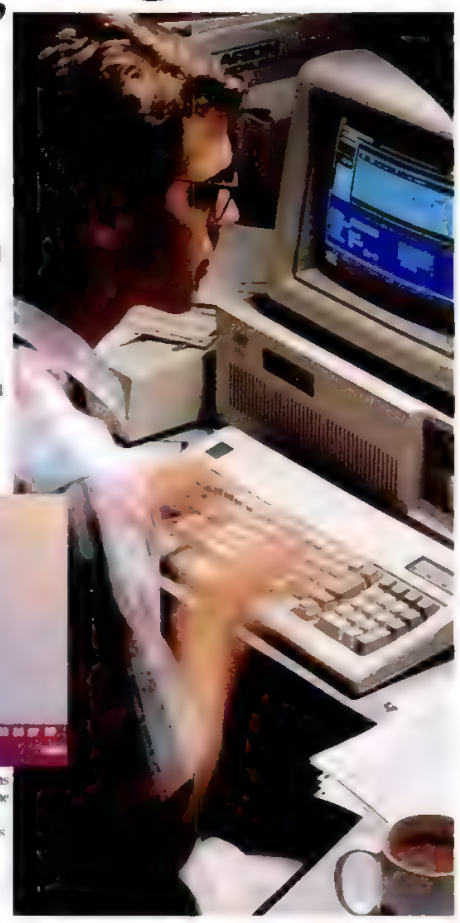

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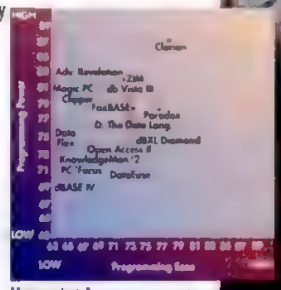

Here's what American corporations in a PC Week survey thought of the power and ease of use of Professional Developer vs. competitors

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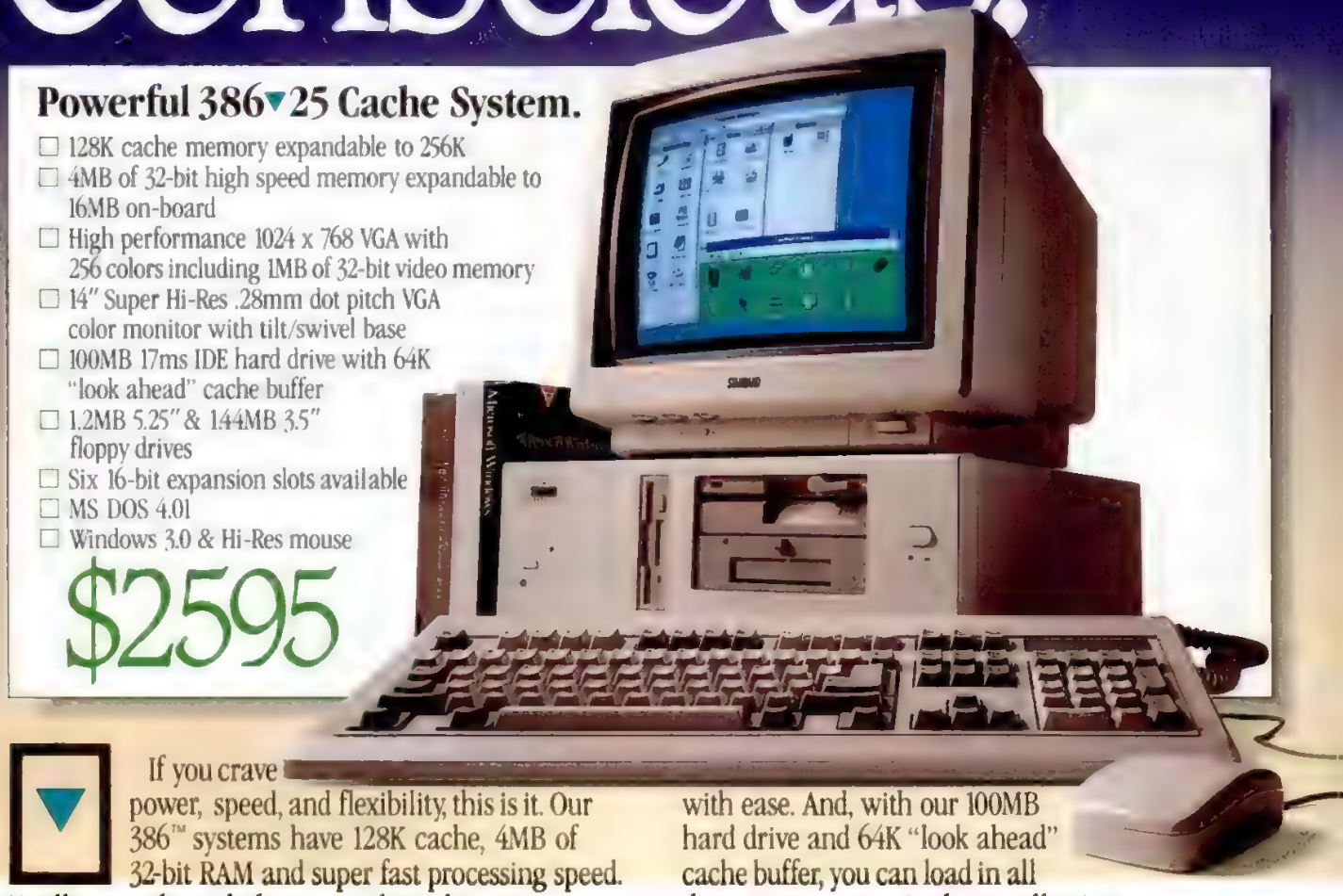

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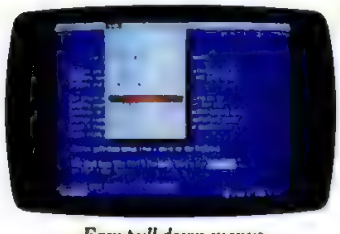

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Portable PCs: An Era of Change

The days of the suitcase-size luggable PC are over; today's state-of-the-art portable PCs handle the most power-hungry applications and still fit in your briefcase. *PC Magazine* gives you 42 portables to consider, including lightweight 80286s and 386s, battery-powered 386SX and DX laptops, 386 AC-only powerhouses, and the IBM PS/2 Model P75 486.

PHOTOGRAPHY: JOHN WILKES

by Bill Howard

"If you don't like the weather in New England, wait a few minutes," goes the old saying. And if you don't see a laptop you like, wait a few weeks. The end of 1990 and beginning of 1991 marks the most profound period of change for the portable computer marketplace since Compaq rolled out its original 28-pound Compaq Portable in the fall of 1982.

Now, we finally have portables you can use.

Until the fall of 1990, your best choices among portables were lightweight notebook computers, weighing no more than 7 or 8 pounds, with processors that had been state-of-the art on desktop computers way back in 1981 and 1984—or else the heavyweights (in every sense of the word), bulky 12- to 18-pound portables with 80386SX and 80386DX processors.

Now you can have your cake and eat it, too. Many major computer vendors—with the notable exception of IBM—offer truly powerful battery-operated notebook computers weighing less than 8 pounds, hardly bigger than looseleaf notebooks, with 20-MHz 80386SX power, crisp VGA display, and hard disks. That's the hottest segment of the portable computer marketplace. And it's only one segment.

We're also beginning to see the first color portables worth buying, 80486-powered portables, ultralight 80286 and 8086 laptops for budget-conscious computing where performance isn't an issue, and better integration of portable computers into the desktop environment. All of this progress has its price, but the price may not be as steep as you fear. Credit the restrained pricing to increased manufacturing efficiencies, greater integration of internal components, and the development of competitively priced notebook computers by leading mail-order vendors such as CompuAdd Corp., Northgate Computer Systems, and Zeos International.

For the second time in a row, we're focusing the year's fifth issue of *PC Magazine* entirely on portable computers. This issue covers 42 new computers in five categories, plus reviews of portable peripherals and file transfer software.

COUNTERPOINTS

by Bill Machrone

I love the rugged construction of the **Zeos 286 Notebook,** coupled with its bargain price. This system has the best, brightest screen, with great adjustment range. Not so great is the location of the screen controls. They're right where your hand tends to grab the machine to adjust its position on your desk or lap, so you're forever knocking the brightness and contrast out of adjustment. The keyboard is well laid out: A little stiffer than I'd like, but very usable.

Compaq really did its homework on the **Compaq LTE 386s/20:** It boots much more quickly than its 8086 and 286 LTE predecessors and packs enormous power into its 7 pounds. On the downside, although I like the keyboard feel, the cursor layout drives me crazy: It's next to impossible to make the transition from desktop to laptop and back again without continually hitting the wrong keys. The LTE pushes the definition of notebook computers to the limit: Carrying its 7 hard-edged, handle-less pounds around between meetings quickly made my hand sore and tired.

As for the **Texas Instruments TravelMate 2000/Sharp PC-6220/CompuAdd Companion** combo, you don't get this much power into such a small space without making some sacrifices. I don't miss the floppy disk; *LapLink* is fine for my purposes. But the designers sacrificed rigidity by making the plastic parts thinner. They also blew some of the details in keyboard layout, having put the seldom-used SetUp key in the upper-right corner, a find-it-in-the-dark location that's better suited to the Del key, which is three keys to the left. Another annoyance: You can't tell whether the machine is charging when the case is closed. Other than that, any of these identical systems is a great machine and currently defines the state of the art in notebook computers. I've adopted a TravelMate 2000 as my daily road warrior machine, so I'll be able to give you firsthand information on how it holds up to daily use.

If there's still a case to be made for non-VGA, non-286 machines, **Toshiba** makes it with the **T1000LE.** This little workhorse is rugged and reliable, with no outstanding faults. ■

THE SX BOOM

80386-based computers have long been the smart buy for the desktop, either in the original DX version with full 32-bit capabilities or in SX form with a hybrid 16-/32-bit data architecture—16 bits outside the CPU on the data path, and 32 bits inside, where it counts most. Either chip works with software that takes advantage of the 386 architecture, especially multitasking environments such as *Microsoft Windows* 3.0 and Quarterdeck Office Systems' *DESQview 386*, which let you switch quickly among several programs.

80386-based portables and luggables date back several years, but the early models were heavy and bulky, and they ran on AC power. It was only a year ago that we saw the first serious battery-powered 386 portables, typified by the 15-pound Dell 316LT and Toshiba T3100SX. They were powered by 16-MHz 386SX CPUs.

Today, the hot ticket is the 386SX portable running at 20 MHz. With the help of a processor RAM cache, performance rises to within a whisker of an uncached 20-MHz 386DX computer. By the time you read this article, you can expect to see several cached 386SX/20s on the market. Once again, Compaq pioneered the way.

Some of the 386SX/20s weigh 10 to 15 pounds, typified by the Compaq SLT 386s/20, GRiD 1550SX/20, and NEC ProSpeed 386SX (20-MHz). Even more exciting are the 6- to 8-pound true notebook portables that have recently hit the market, such as the Compaq LTE 386S-20. Companies such as AST Research, Everex Systems, Librex, Texas Instruments, and Zeos are just beginning to ship their lightweight answers to that state-of-the-art notebook.

A VGA display is de rigueur on any decent laptop today, and most have improved their gray-scaling abilities. Good laptops can render colors in 16 or 32 gray shades—not just 4 or 8—although you'll be hard-pressed to see 16 *distinct* shades. Gray scaling is important not only for graphics but for such mundane tasks as word processing, to distinguish normal, boldface, and marked blocks of text. Displays on most good laptops measure 9 or 10 inches diagonally, and they provide the same 4:3 (width/height) aspect ratio as desktop CRTs.

SX-based PCs also provide substantial performance improvements over 286 laptops. On PC Magazine Labs' 8086 Instruction Mix benchmark test, perhaps the most significant measure of PC performance, the best 20-MHz SX portables are faster by two-thirds than your garden-variety 12-MHz 80286 portable. (All told, the range in performance from the fastest 486-based machine to the slowest 8086 system is about 10 to 1. See the accompanying performance comparison chart for a breakdown of power by processor type.)

ROOM FOR IMPROVEMENT

Even the best laptop and notebook computers have their drawbacks. Three stum-

bling blocks you'll encounter on the most desirable machines are small hard disks, limited battery life, and the lack of color.

The 2.5-inch hard disk is one of the "enabling technologies" of a true notebook computer. But with one exception it has been limited to a capacity of 20MB. This amount of storage is fine if you're trading in your two-floppy-disk laptop, but it's downright wimpy when you've been using a desktop PC or husky 386 portable with 3.5-inch hard disks, where capacity starts at 40MB.

Industry leaders Conner Peripherals, PrairieTek, and others promise 40MB drives this year. In the meantime, if you need more capacity than 20MB in a notebook computer, look to the Compaq LTE 386s/20, which has a 30MB 2.5-inch drive from Conner Peripherals, or learn to live with 10- to 15-pound portables with 3.5-inch drives. Or wait another few months. By then, the 40MB 2.5-inch disks should be available, and the LTEs/20 should have a 60MB drive.

Battery life gets a little bit better every time we review portables, but in most machines a nickel cadmium battery pack still lasts only 90 minutes to 3 hours. Until recently, better battery life was almost completely the result of making your laptop use less power, rather than having the battery pack produce more power.

Nickel hydride shows promise. It's making its debut in Toshiba's upcoming 386SX notebook machine, the T2000SX. Toshiba says that nickel hydride batteries pack 22 percent more power per ounce than nickel cadmium, and they pose less of an environmental hazard.

Another trick to getting more power involves repackaging nickel cadmium battery material to make it denser, providing more power (and more weight) per cubic inch of battery. You'll see the result advertised as high-density batteries, and they currently cost about a third more than nickel cadmiums. (See the sidebar "Nickel Metal-Hydride: A Kinder, Gentler Battery.")

COLOR: IT'S COMING

For a portable to be competitive with desktop PCs, it needs a color display. Today's color displays, as offered by NEC, Sharp, Toshiba, and a handful of others, fall into one of two broad categories: cheap but not very good, and adequate but expensive. Both technologies are currently restricted to AC-powered portables.

The better color displays use *active matrix*, or *thin-film transistor (TFT)*, technology. A tiny transistor sits behind each pixel of the liquid crystal display, allowing precise control of each pixel. Images are crisp, as they should be for a premium of $2,500 to $3,000 over a comparable monochrome portable.

The cheaper *passive matrix* displays lack the TFT technology, so colors aren't as vivid, and the screens are prone to smearing when the images are moving or when you are scrolling or moving a mouse. Expect to pay a premium of about $1,000 for passive matrix displays, as on the Toshiba T5200C.

COMPUTING ON THE CHEAP

Not everyone wants to pay $3,000 and up for SX-based notebook portables. While we believe you're better off with an SX, more than a few manufacturers have developed enticing 80286-based notebook machines with hard disks for a street price (that is, an actual selling price) of about $2,000.

Many vendors are selling 286 laptop and notebook units while they marshal the technology to build truly downsize 386SX

COUNTERPOINTS

by Bill Howard

Compaq's LTE 386s/20 tops the 20-MHz SX class: lightweight, small footprint, great battery life, superior error-correcting modem, and more disk storage than any of the other lightweight notebooks now entering the market. Two niggling complaints: The awkward cursor key layout that has become as much a Compaq tradition as Compaq's "Call-your-dealer-for-support" mantra, and a screen that (while bigger and brighter than other LTE models) could stand to be a bit crisper in text mode. Compaq has always had the best-selling portables; with the LTE 386s/20 it has the best portable as well.

Andy Warhol must have had the **GRiDCase 1550SX** in mind. Early last fall, GRiD Systems Corp. had the smallest, lightest 20-MHz SX portable PC around—for the proverbial 15 minutes, anyway. Since then, a slew of sub-10-pound notebook 386SX-20 computers have put the 12-pound GRiD in perspective. The screen is good, the overall size is passable, and GRiD has become much more competitive on price recently. But the built-in IsoPoint mouse substitute just in front of the Spacebar takes some getting used to.

Less than a year old, and the **NEC ProSpeed 386SX-20** seems dated already. It's got a big, easy-to-read screen and a good keyboard (detachable, as in the Compaq SLT line), but the machine is just too bulky and, at 13 pounds, a bit overweight. As a desktop replacement that you can take home on weekends and on the occasional road trip, the ProSpeed 386SX-20 is okay. Just hope you're flying out of Gate 1, not Gate 91.

For portable computers, there are two kinds of color technology: active matrix, which looks pretty good and costs a lot ($2,500 to $3,000 more than a monochrome display), and passive matrix, which is cheap (so to speak, at $1,000 extra), a bit faded, and prone to smearing anytime an object moves on-screen. Because the **Toshiba T5200** already costs nearly $9,000 in its monochrome version, Toshiba opted for the cheaper passive-matrix display on the T5200C. The combination screams out "Compromise!"

If you don't feel the need for speed, Toshiba's 6.5-pound, 80C86-based **T1000LE** is a nice package for lightweight word processing. Unlike previous T1000 iterations, this one has both hard and floppy disk drives, but battery life—a bit under 2 hours—is disappointing. And shouldn't you really be looking at 286 notebooks?

The **CompuAdd Companion, Sharp PC-6220,** and **Texas Instruments TravelMate 2000** pack an amazing amount of 286 technology into 4.5 pounds. Perhaps too much technology? Move the ultrathin screen back and forth and the case flexes. That's not a scientific measure of ruggedness, to be sure, but it makes you curious about how these systems will hold up over time. *PC Magazine* is putting several into extended-use tests to find out.

Except for an ungainly power transformer, the **Zeos Notebook 286** seems like a fine all-round machine (especially with its sharp VGA display) at an attractive price. ■

notebook computers. One example: Zenith Data Systems' 9-pound SlimsPort 286, halfway between where the Zenith SupersPort portables have been (14 to 15 pounds) and where they need to be if they are going to be truly competitive (6 to 7 pounds).

All portable computers require the FCC's Class B clearance, since portables are likely to be used outside the office.

If your needs don't go much beyond word processing and checking your electronic mail from out on the road, you can get by with 8086 notebook computers. You won't find many new low-end offerings, however. In this issue, we have only two new notebook computers, from Psion and Toshiba America Information Systems, plus a curtain-call review of Compaq's best-selling LTE.

When you consider whether to buy into 8086, 286, or 386SX technology, remember to consider the price of the complete system. When you add a modem, spare battery, carrying case, DOS, and software, the cost of these components remains the same, but the percentage difference decreases as you move to higher processor levels. Where you might spend $2,000 for an inexpensive 8086 system, you can easily add $500 worth of options. Add the same options to a $4,000 system and the difference seems less substantial.

SHOULD YOU WAIT?

If laptops get better every few months, why not wait half a year and buy a truly superior machine? If you wait, you're likely to find even more 7-pound 386SX notebook computers and somewhat lower prices.

Don't expect any revolutionary breakthroughs in screen quality, affordable color, or battery life in the short term future. By the middle of 1991, you should see notebook computers with 40MB or 2.5-inch hard disks, and in the second half of 1991, you should start to see notebook computers based on Intel's low-power 386SL integrated chip set, which combines a 20-MHz 386SX CPU, memory controller, cache controller, and peripheral subsystem on two VLSI chips.

Also look for laptops that run with Microsoft DOS 5 or Digital Research's DR-DOS 5. Both operating systems were tweaked to extend battery life, for instance by slowing down the CPU when it's not active. Battery life is optimized when the computer is built with one of the new operating systems in mind.

Later in the year you may find a wider variety of 80486-based AC-only portables. For now, there's only one: the IBM PS/2 Model P75 486. PC Labs received a dozen other 486 portables from vendors seeking reviews, but on further investigation we found that none of them had received FCC certification. All portable computers require the FCC's stringent Class B clearance, since portables are likely to be used outside the office (the only place Class A computers can legally be used). And as contributing editor Winn Rosch explains,

COUNTERPOINTS

by Gus Venditto

Toshiba's new color machine, the **Toshiba T5200C,** is a real breath of fresh air. The color looks more natural than other vendors' earlier attempts. Unfortunately, the T5200C is likely to be a showpiece rather than a workhorse. Since this system comes with a 19-pound handicap and a $10,000-plus price tag, you'll probably use the T5200C only if you absolutely, positively need portable VGA color. If that's the case, you should snap one up before they're all gone.

The **Dolch 386/25C** is built like Mike Tyson—lots of power in a wide, formidable body. Unfortunately, the system suffers from one key flaw: The screen can't be tilted. That's fine if you do all your work standing in front of a counter, but if you try to use it on a desk, you may find it's as unyielding as Mike Tyson, too.

The **NEC ProSpeed 386 SX/20** seems like a good choice if you want a portable that can double as a desktop PC. It has a great display, so you won't need to add an external monitor, and with the expansion chassis, you've got a great movable desktop. I wouldn't recommend it to anyone of average build who plans on moving it more than a couple of times a month.

The **GRiDCase 1550SX**'s IsoPoint mouse substitute is so radical an innovation that it's hard to concentrate on the machine as a standard laptop. And that's good, since the system is overpriced. The IsoPoint's sliding rail-pointer is a good try, but I found myself making too many mistakes to want to take it home. I'd rather use my thigh as a mousepad than spend time with the IsoPoint.

The **Sharp PC-6220/CompuAdd Companion/Texas Instruments TravelMate 2000** triplet is nothing short of a new landmark. Choosing among the three is a question of which vendor you'd prefer to deal with. Deciding whether you need one is simple: Do you have to run *Windows* 3.0 or another powerful application on the road? If yes, then buy.

The vital statistics on the **Zeos Notebook 286** look good on paper—almost too good. The combination of 12.5-MHz 286 speed and a decent hard disk for $1,995 is a radical recasting of the laptop equation. I looked long and hard for the catch: There is no catch. The Zeos Notebook 286 is one incredible bargain. The backlit VGA screen is one of the brightest and sharpest I've seen. The keyboard arrangement and feel are first-rate. Zeos gives the CompuAdd/Sharp/Texas Instruments 286s a run for the money, and based on Zeos's record for service, if I were to trade in my NEC UltraLite, I'd put my money here. I found it one of the more refreshing surprises of the group.

With the **T1000LE,** Toshiba has refined an already highly advanced art form. This system shows that Toshiba best understands what people need from a laptop. Any laptop requires compromises. The Toshiba T1000LE's compromises seem to be based on what real people want in a laptop: a truly portable machine that handles most pre-*Windows* 3.0 applications well. ■

NICKEL METAL-HYDRIDE: A Kinder, Gentler Battery

Nickel metal-hydride technology promises a cleaner and more powerful future for rechargeable batteries.

by Bill O'Brien

Until now, speed, storage, and color video came at the expense of battery life; you couldn't have everything. But with nickel metal-hydride battery technology emerging, the ultimate laptop is coming closer and closer to fruition.

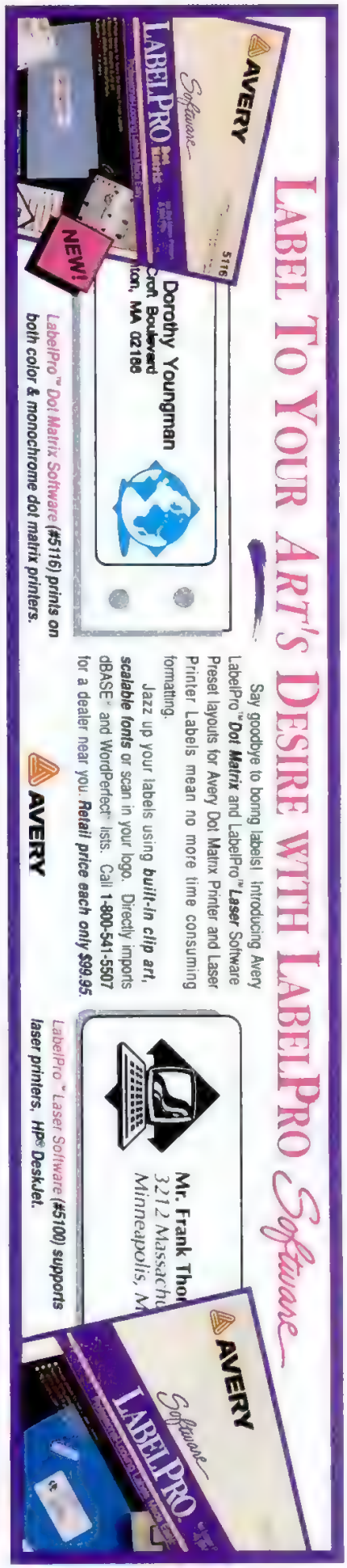
In design, nickel metal-hydride batteries resemble nickel cadmiums, but metal hydride replaces the cadmium and results in a more powerful battery. Consider that the typical AA-size nickel cadmium battery has a 480mAh rating—that is, it will produce 480 milliamperes of current for 1 hour at or near its rated voltage. The equivalent-size metal-hydride battery might have an 1,100mAh capacity, more than twice that of its predecessor. Potentially, this means that metal-hydrides could easily produce 70 to 100 percent more current than their nickel cadmium equivalents. In the beginning, however, you can expect to see more modest gains. Toshiba, for instance, says that its metal-hydride-powered Toshiba T3200SX portable (due to ship later this spring) will run about 22 percent longer than systems that use nickel cadmium batteries.

Metal-hydrides hold a second benefit over traditional nickel cadmium batteries: While cadmium is classified as a toxic material, metal hydride is not. If your nickel cadmiums leak when you discard them, the cadmium that is released will poison the environment. The EPA has not classified metal hydride as toxic—at least not yet.

There are, however, a few drawbacks to this new technology. While both nickel cadmium and nickel metal-hydride batteries have similar charging requirements, the latter may require a different type of charger. Metal-hydride batteries, for example, cannot be charged by the peak-detect fast chargers currently in use with standard laptop units.

Perhaps more significant are the topics of availability and pricing. Metal-hydrides may just be appearing when this issue goes to press, and they probably will not be available in quantity until later in the year. And because the technology is so new, you'll be paying for the batteries' development costs up front. You can expect the initial run of metal-hydrides to be twice the price of nickel cadmiums.

If hydrides remain a costly alternative, that will change as both supply and demand increase. And these batteries will let you maintain the same running time using relatively power-hungry components. That means faster processors, more memory, bigger hard disks, and color displays may soon fit into a 15- to 18-pound laptop that still runs for 2 hours. With such power available in such a small package, desktop machines could indeed become scarce. ■



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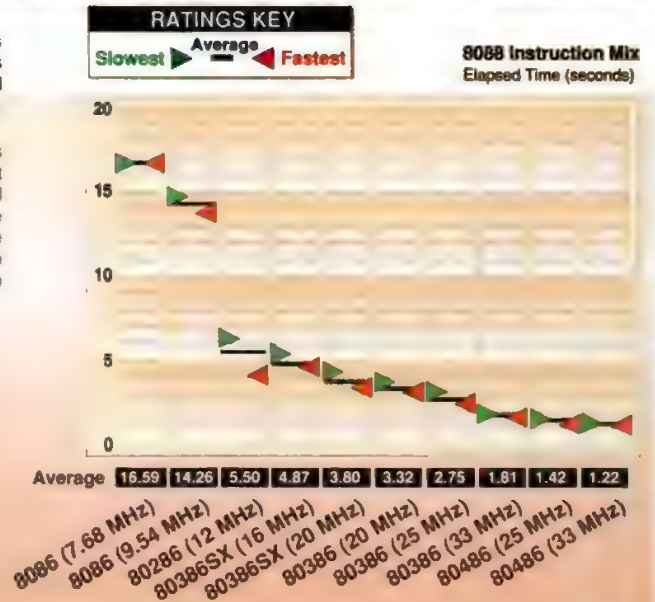
PORTABLE PERFORMANCE: A COMPARATIVE VIEW

The 8088 Instruction Mix benchmark test times a series of tasks specific to the 8088 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

PC Magazine Labs runs this test on every PC we review, regardless of processor level or speed (although typically we publish the result only for 8088/8086-class machines). Here, we present a general picture of the machines we received for this issue in terms of three numbers: slowest, average, and fastest. "Fastest" represents the machine with the best test score in its class; "slowest" is just the opposite. The average score represents a composite of all PCs with a particular processor type and speed rating

A clear jump in processor performance occurs when going from an 8086 to an 80286, as shown by our 8088 Instruction Mix test. Upgrading from a 286 to a 386SX bridges another performance gap: Compared with an average 12-MHz 286 processor, an average 20-MHz 386SX yields a performance gain of about 45 percent. In our tests, the only instance where a faster processor failed to produce faster overall performance occurred when the 25-MHz 486s beat the 33-MHz 386s—a result of the 486's built-in math coprocessor and internal cache.



most of the 486 wannabes sorely lacked the construction quality the FCC's standards demand.

BUYING RECOMMENDATIONS

If you'll be buying a portable computer, keep these thoughts in mind:

- If you're comparing different brands, make sure you're comparing apples with apples. Some vendors include DOS and possibly a carrying case.
- Try to get your portable with at least 2MB of memory, preferably 4MB if you're shopping for a 386. This lets you run several programs at once and use a disk cache, which speeds data access. The disk cache can also extend the battery life: If you set the hard disk to shut down after several minutes' inactivity, the information you want from the disk may actually be in the cache, and you won't need to access the hard disk to retrieve that data.
- Watch for rebates, free-software bundles, and gifts with the purchase of your laptop. Slow-moving portables may command a $100 rebate, or $250 to $500 in some cases if the machine is due to be phased out. Some vendors kick in a free copy of *Microsoft Windows*. One vendor gives away a cellular phone. (You still pay for the calls, of course.)
- Battery life among notebook and laptop portables varies considerably; the best can last for nearly 3 hours. You may see trends within product lines. For example, most Compaq machines seem to fare well on PC Labs' Battery Rundown tests, Toshiba SX machines have been a bit above average, and some smaller Toshiba machines have been worse than average.

Among the 42 portable computers reviewed in this issue, you're sure to find one or more that are well suited to your needs.

- If you're shopping for a modem, look to vendors with error correction and data compression. Look for at least MNP Level 4 and 5 (error correction and data compression, respectively) or, better still, V.42/V.42bis, which includes MNP 4.
- Docking or expansion stations provide fast connections for your laptop when it's back in the office, but at what price? The expansion units can cost up to $1,500, and many portables have all the power, storage, memory, and I/O you need.

ABOUT THIS ISSUE

This single-topic issue of *PC Magazine* comprises seven sections. We begin with reviews of battery-powered 80386SX and 80386DX portables, 80386 AC-only portables, 80286 battery-powered notebook portables weighing less than 7 pounds, 8086 battery-powered notebooks, and 80486 portables. We also review portable peripherals—printers, modems, and external hard disks to take with you—and then take a look at nine file-transfer programs designed to move your data between laptop and desktop PCs.

We're reviewing new portables that *PC Magazine* has not previously reviewed. In addition, we have brought back for review many of the Editors' Choice portables from two previous issues: the blockbuster portables issue of March 13, 1990, and "Power Portables: The Next Wave," October 16, 1990. The introduction to each review section updates you on portables that were announced but had not shipped in time for our deadlines. Among these 42 portables, you're sure to find one or more that are well suited to your needs. ■

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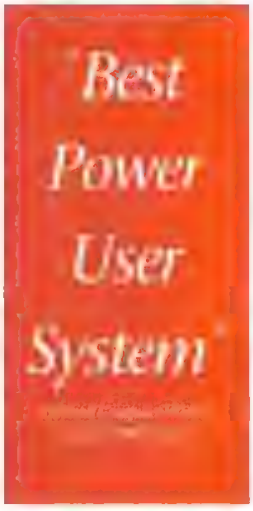

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PC Magazine, Best of 1989 Awards January 16, 1990 issue

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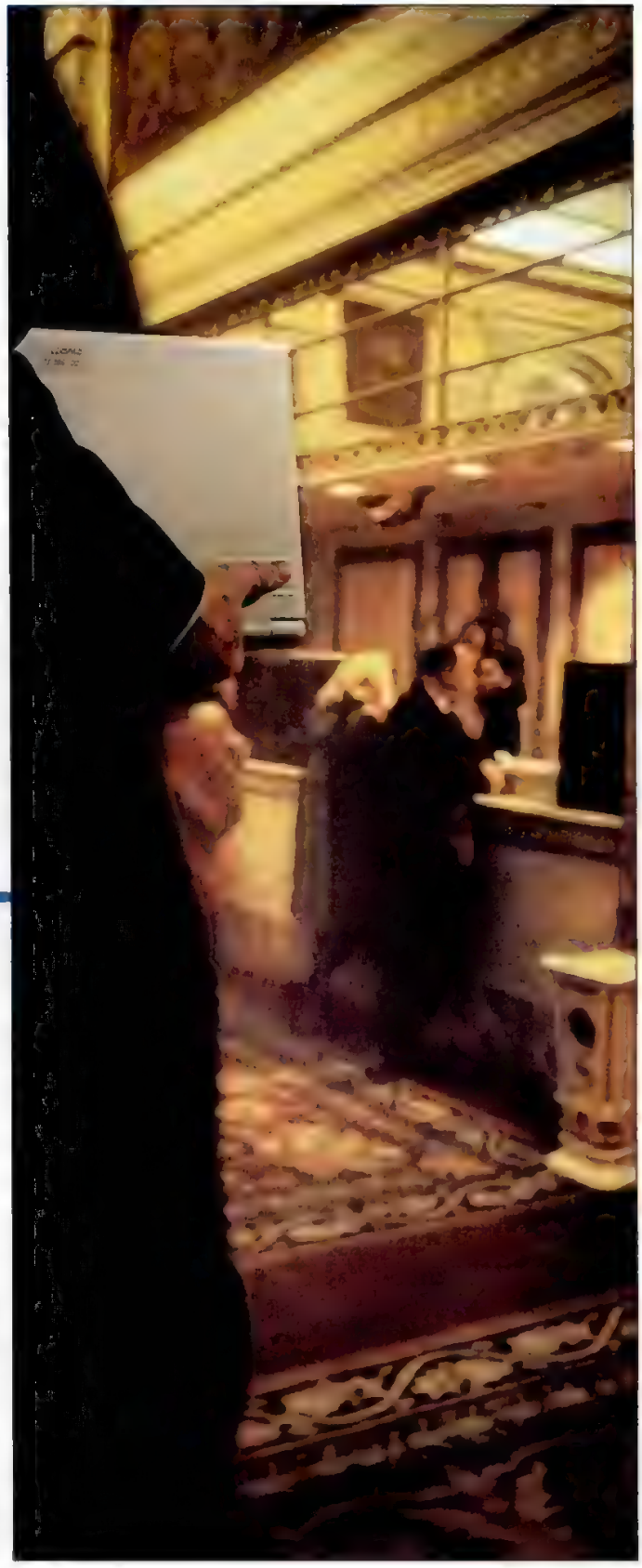
Battery-Powered 386SXs and 386DXs

Battery-powered notebooks and laptops have taken over the portable PC market. Here are 3 386DXs, 11 386SX/16s, and 9 386SX/20s, including the cached 386SX/20 notebook that shows the wave of the future.

by Bill O'Brien



PHOTOGRAPHY: JOHN WILKES

In 1985 a portable computer was a curiosity, something akin to a calculator with a thyroid problem. The 1985 machine took its power from lowly alkaline batteries, and most portables rivaled portable stereos in their voracious appetite for electrical power. Nickel cadmium batteries were still an option instead of a standard. Very few end-users took portable computers seriously enough to think of them as a long-term investment.

By 1987 things had changed substantially. *PC Magazine*'s executive editor Bill Howard posited that the ideal laptop would weigh 4.5 pounds.

It would include a 9.54-MHz 80C86 or 12.5-MHz 80286 CPU, 1MB of nonvolatile memory, software in ROM modules, an 81-key keyboard, side-mounted I/O ports (including an external video port that supported IBM's then-brand-new VGA standard), and a removable, backlit, supertwist LCD screen. The whole package would be powered by four penlight batteries that would carry it along for 10 to 15 hours. Its options ought to include an expansion unit that added 5 pounds and either two floppy disk drives or a combination of a 3.5-inch 1.44MB floppy disk drive and a 20MB hard disk. The expansion box should also have room for an additional 1MB of RAM and provide battery power for 6 to 8 hours. All together, the dream machine should cost about $2,700.

In large measure, 80286-based portables have realized that dream. Portables employing Intel's relatively power-hungry 80386SX processor, on the other hand, have yet to achieve the optimum weight-to-computing-power, though a new crop of notebook 386SXs that should be shipping by springtime will achieve that goal.

The 80386SX- and 80386-based portables in this section range from 11 pounds to just under 15 pounds, with the exception of the Compaq LTE 386s/20 Model 30, which weighs slightly more than 7.5 pounds. The systems' natural number-crunching and graphical user interface capabilities demand at least 2MB to 4MB of memory and a 40MB hard disk. VGA-compatible, backlit, supertwist LCD screens are most prevalent, and Super VGA–capable external monitor ports are often the rule.

Naturally, a portable machine with this kind of storage, RAM, and video capacity running at 16- or 20-MHz, requires a good deal more juice than the amount that can be provided by four penlight batteries, and rechargeable nickel cadmium battery technology has filled the bill so far (see the sidebar "A Kinder, Gentler Battery"). Nevertheless, a move to larger, increased-capacity nickel cadmium cells, while enabling these extra-duty components to operate for as long as 3 hours on a charge, has also contributed to these portable computers' weight problem.

Price, too, hasn't yet gone low enough for many end-users to justify the reduced expansion capabilities and other limitations of this form—though list prices have come down significantly in the past year. Although some battery-powered portables can be found for under $3,000, most of

EDITORS' CHOICE

- **Compaq LTE 386s/20 Model 30**
- **Dell 316LT and 320LT**
- **Toshiba T3100SX**

One battery-powered system stands head and shoulders above all the rest: the Compaq LTE 386s/20 Model 30. The system that is rewriting the rules for portable computing stuffs an amazing amount of technology into a 7.5-pound package.

Look at what Compaq gives you: a 20-MHz 386SX processor with a built-in processor RAM cache; user-friendly RAM expandability; one of the fastest hard disks on the market; crisp display with some of the fastest scores on our tests, and true notebook dimensions. Best of all, the LTE 386s/20 gives you more battery life than any other system in this roundup: nearly 3 hours. The price for this package? Nearly $1,000 per pound: $6,499 for a unit with 2MB of RAM and a 30MB hard disk. The only possible drawback is an awkward keyboard.

While no system compares from a purely technical standpoint, other systems rate Editors' Choice status for the amount of performance they offer for their prices. Consider, for instance, the Dell System 320LT, replete with features at $3,899 for a 2MB system with a 40MB hard disk. Though this system is heavy at 15 pounds, it scores points for its expandability to 8MB, its good keyboard design, and its very fast, readable video. The Dell 316LT won Editors' Choice in *PC Magazine*, March 13, 1990, and is still a fine machine. But for a better-performing, fully loaded system, you should think seriously about moving up to the 320LT.

The $5,699 Toshiba T3100SX retains its Editors' Choice award, even though some of its test scores are on the slow side. The outstanding keyboard design, the fast gas-plasma display, and the overall ruggedness of this system never go out of style. Of course, this makes us hold our breath for the T2000SX, which was scheduled to ship in February but failed to make our review deadline.

Three systems deserve honorable mention: the GRiDCase 1550sx, the Compaq SLT 386s/20 Model 120, and the NEC ProSpeed SX/20. GRiD scores points for its innovative IsoPoint mouse substitute, but the device still needs some refinement and takes a coordinated hand to operate smoothly. This system performed admirably on our benchmark tests, and comes with a terrific thin-film-transistor screen—the kind that made the CompuAdd Companion/Sharp PC-6220/Texas Instruments TravelMate 2000 notebook famous. But its price ($6,345 with 2MB of RAM, a 60MB hard disk, and DOS) can escalate too quickly once you begin adding all the options you may want.

Compaq's previous-generation SLT 386s/20 won Editors' Choice in our issue of October 16, 1990, but it now walks in the shadow of the superb LTE. Sure, you have Compaq technology and the extra capacity of the 120MB hard disk, but at $7,649 for a 2MB system, you're paying a hefty premium to lug this 15-pounder around. Consider it if you need the giant disk.

Finally, the NEC ProSpeed SX/20 is worth your consideration. This system has made significant improvements over the older ProSpeed SX/16; most significantly, it has shed nearly a quarter of its weight and now tips the scales at about 13 pounds. Its price, at $6,398 with 2MB of RAM and a 40MB hard disk, will come down about 30 percent, since the system is sold through retail dealers.

If you really want a lightweight PC, however, keep your eyes open for the newest crop of 7- to 9-pound 386SXs in looseleaf-size 8.5- by 11-inch cases. They're just around the corner, and they promise to bring new dimensions to notebook computing.

TAKING CHARGE

Battery technology is improving, but only you can make your nickel cadmium last.

by Bill O'Brien

No component is more often overlooked and mishandled than your laptop's battery. But with a little attention to its requirements, you can both lengthen the time between charges and increase the number of charges each battery will provide.

Virtually all rechargeable batteries currently installed in laptops are made from nickel and cadmium. How long your computer will run depends on the simple ratio of your nickel cadmium battery's work ability—measured in milliampere-hours—to the amount of current your portable uses.

A nickel cadmium battery can be effectively recharged as many as 1,000 times, giving it a life span of up to three years if you discharge it once a day. But a number of factors determine the amount of work your battery can do on a single charge, as well as the battery's actual life span.

THE MEMORY EFFECT

Early rechargeable portable systems ran until the battery discharged completely. If you were working when your laptop's lights went out, you were out of luck.

To prevent this, systems were designed to warn you when the batteries were about to expire so you could safely save your data. These systems work by taking advantage of the voltage characteristics of nickel cadmium batteries. When fully charged, a nickel cadmium battery rated at 1.25 volts may have an actual measured level of 1.5 volts. As the battery discharges, its voltage level drops. Just before exhaustion, the level is about 1.1 volts. A voltage-sensing system detects this condition and sends a warning via a flashing LED or a beep, or both.

Unfortunately, this system's benefits can cause battery problems down the road. If your portable's voltage-sensing system varies in its accuracy even by small amounts, you may be cued to recharge your batteries before they're fully discharged. This is known in laptop circles as "the memory effect."

Over a consistent period of time (perhaps a month or two with daily use), your batteries will be "trained" to expect recharging at that level—say 1.2 volts instead of 1.1—and they will effectively lose some of their capacity. It is as if your car's engine went dead because the gauge read "empty," even though you had a gallon of gas left in the tank.

LESS WAIT, MORE HEAT

Another set of problems is caused by tradeoffs in charging techniques. In early laptops, recharging could take up to 18 hours. The laptop's AC transformer used a *trickle-charging* method that fed the pack at a very low amperage. Although trickle charging drastically increased recharge time, it was easiest on your nickel cadmium battery, promoting more work ability and longer life span. Nevertheless, the long recharge times made for awkwardness on the road, requiring users to carry extra batteries or face long periods of downtime.

Consequently, vendors have begun to supply portables with fast chargers that need as little as 1 hour per recharge. But this gain in usability is offset by damage to the battery. Newly fast-charged batteries are warm to the touch. The additional heat is a sign that the chemical reaction that creates electrical potential is occurring too quickly. Heat damages nickel cadmium batteries, and for most fast-charging systems, the life span of the battery pack is usually rated at about 500 recharges—half of the theoretical 1,000-charge life potential.

Worse still, and fortunately rare, are fast chargers that quickly overload a fully charged battery. All batteries begin to discharge immediately after they reach full charge, exactly as nonrechargeable batteries do. *Peak-detect* or *negative-voltage-change* chargers monitor the voltage and switch to trickle-charge when the battery is charged and the voltage begins to drop. At this point, true trickle-charging maintains the correct battery level no matter how long the charging continues. Chargers unable to trickle-charge will pour higher amperage into an already charged battery, damaging it further by creating more heat. Continued fast charging can burn out a battery pack overnight.

CHARGING AHEAD

How do you keep your batteries in shape? The answer is to do manually what your laptop and charger don't do automatically.

To fight "the memory effect," once a month you should turn off the power-save features, turn down the display brightness, and let the machine run down until it stops on its own. This will help drop the battery's voltage to its original minimum and squeeze every drop of work ability out of it.

If your machine won't allow a complete power-down, let your portable system's AC power pack trickle-charge the machine overnight when the system is on. Again, turn down the screen brightness and shut off the power-save features. Do this once out of every three charges. In the morning you can zap the machine with a fast charge for the half hour or so that it takes you to get ready, but your batteries prefer the slow charge method.

To help mitigate the damage caused by fast-charge heating, try not to use your portable immediately after recharging the batteries. Instead, let the battery cool down for at least half an hour before you power up. Likewise, don't start a recharge cycle immediately after the battery is exhausted. This, too, generates damaging heat.

For a portable that sees daily use, an optimal situation would be to have three battery packs available. Use one while another is recharging and the third is resting. This will save you the price of a battery pack and a half over a three-year period. ■

them cost between $3,000 and $5,000; a few soar to $7,000 and higher. Many of these systems are dealer-distributed, so you may be able to find an occasional $2,500 bargain on the street.

LOOK WHO'S HERE

With these parameters in mind, in the following pages we review 25 machines from Acer, Bitwise, Bus Computer Systems, Commax, Compaq, CompuAdd, Dataworld, Dauphin, Dell, Fora, GRiD Systems, Hyundai, NEC, Network PC, Peregrine, Sharp, Tangent, Toshiba, Twinhead, and Veridata.

In many cases, however, the name on the cover is different from the name of the actual manufacturer. In this roundup, we saw seven 16-MHz 386-based systems manufactured by Sotec (based in Yokohama, Japan), all with different labels and slightly different components and company policies, sold by Bitwise, Bus Computer Systems, CompuAdd, Hyundai, Network PC, Peregrine, and Tangent. We reviewed another pair of twins from Twinhead and Commax (both using Twinhead motherboards), and a pair of 386SX/20s with Chaplet motherboards, marketed by Tangent and Fora.

No longer the curiosities of five years ago, portable computers have become a formidable force, with nearly half of all computing done on them.

Possibly as impressive is the list of those computers that are not part of this review. They include Altima Systems' NSX, AST Research's Premium Executive 386SX/20, Austin Computer Systems' 386SX/20 notebook, Bondwell Industrial Co.'s B310SX, C^2 Microsystems' 386SX, Copam's LT 386SX, Cordata Technologies' 386SX Laptop, Everex Systems' Tempo LX, Fora's SX Model 50, GoldStar Technology's 386SX Laptop and 386SX Notebook, Leading Edge's D/LT 386SX, Librex Computer Systems' Librex 386SX, Micro Generation's 386SX-16, Mitsuba Corp.'s 386SX, Polywell Computers' Poly 386SX-LCD, Premier Computer Innovations' 6500, Proteus Technology Corp.'s 386SX-20, Samsung Information Systems' NoteMaster 386S/16, Texas Instruments' TravelMate 3000, Toshiba America Information Systems' T2000SX, Transource Computers LT-5300, and Twinhead Corp.'s Twinhead Supernote 386. For most of the machines not reviewed, it was merely a case of "it's almost here, but not quite": We've already seen many such systems as preproduction samples.

FUTURE SCAN

For those who wish that the future of laptops were found outside of the SX domain, it appears that a partial solution is in the works. Intel's 80386SL and its promise of a 4- by 6-inch motherboard with built-in power conservation seems to be the next wave. The SL's enhanced SX design should increase the number of 80386-based notebook computers, and that will exert price pressure on larger, older-technology machines. Vendors are, unfortunately, already beginning to worry over Intel's ability to supply a sufficient quantity of SL chips.

Jim Seymour has predicted that the future of computing is in downsizing, and nowhere is this more evident than in the portables arena. Integral Peripherals is marketing a 2-inch hard disk, and on its heels is IBM with a 1-inch drive. Quantum, Western Digital, and Conner Peripherals are currently developing similar projects. Both IBM and Toshiba have large-capacity floppy disk drives in the works; Support for their formats from DOS 5.0 could signal a return to the concept of non-hard-disk-based, battery-operated superlights.

Less ethereal are prognostications for the portable PC market role over the long haul. Analysis of the portable's 1989 market share shows that portable computers have taken over at least 10 percent of the market with $2.4 billion in sales of 834,000 units. That's an increase over 1988, and the expected continuing increases push portables up to a 40 percent market share by 1994. No longer the curiosities of five years ago, portable computers have become a formidable force. And with nearly half of all computing being done on them, portable PCs are going to need every ounce of added potential that's available.

You can expect that desktop units will benefit from the smaller, more efficient 80386-based components developed for a continually growing portable computer environment.

ACER AMERICA CORP.

Acer AnyWare 1100LX

by Bruce Brown

If you like the design concept that originated with the Compaq SLT—a portable computer with an easy-to-read screen, a removable keyboard, and a case that fits easily on an airplane fold-down tray—Acer's AnyWare 1100LX gives you what you want. Best of all, it can cost up to $2,500 less than the Compaq.

At 13.7 pounds including the battery, the AnyWare 1100LX weighs about 2 pounds more than many laptops in this roundup, but the 4.1- by 14- by 8.5-inch

Acer AnyWare 1100LX, $4,215.

(HWD) machine has room for lots of add-ons with its multitude of ports (one parallel, one serial, one PS/2 mouse, one PS/2 external keyboard, one external 15-pin analog VGA, one external floppy disk drive, and one expansion chassis). In its standard $4,215 configuration, the 1100LX comes with 3MB of RAM, a 40MB 25-millisecond Conner IDE hard disk, a 1.44MB floppy disk drive, a 16-shade VGA display, an 82-key Acer keyboard with an embedded numeric keypad, a 2,400-bps

FACT FILE

Acer AnyWare 1100LX
Acer America Corp., 401 Charcot Ave., San Jose, CA 95131; 800-SEE-ACER, 408-922-0333.
List Price: With 1MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 3.3, file transfer software, $3,796.
Options: 1MB RAM upgrades, $110; 2,400-bps modem, $199; extra battery, $99; AC power adapter, $129; expansion chassis, $399; external 1.2MB floppy disk drive, $359; external numeric keypad, $79; carrying case, $99.
In Short: A moderately priced Compaq SLT-style laptop, the 16-MHz 386SX Acer AnyWare 1100LX has a superior 16-shade display, familiar 82-key keyboard, and ports galore. Two-hour, 20-minute battery life is a plus, but the 13.7-pound weight is still a bit heavy for travel—especially after you add the extras.

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internal modem, and DOS 3.3, as well as file-transfer, extended-memory, and video utilities.

Acer manufactures many of the 1100LX's components, including the 16-MHz motherboard, which uses a Headland Technologies 386SX chip set and Acer's own BIOS. The BIOS supports system and video BIOS shadowing as well as BIOS-level passwords. The motherboard also contains a socket for an 80387SX math coprocessor.

The 1100LX can accommodate a maximum of 5MB of RAM. You can expand the 1MB of memory in the base-configured machine by adding two 2MB 100-nanosecond DRAM SIMMs.

The Acer's 6- by 8-inch display supports 16 shades of gray in its maximum 640 by 480 VGA resolution; it is driven by the system's Cirrus Logic video chip set. The backlit screen uses triple supertwist nematic LCD technology, which makes its resolution about as fine as any you'll find on a portable. No other notebook in this group uses this state-of-the-art technology. In addition to VGA, the system handles MDA and Hercules video modes. You can hook up an external monitor to the 1100LX via its 15-pin analog VGA port, but you can't use the external and the internal display simultaneously.

The Acer's rechargeable battery has a rated life of 2.5 hours; recharge times are 1.5 hours using the 1.8-pound AC adapter/battery charger with the system off and 5 hours with the system on. You can extend the life of the battery by setting shutdown intervals for the screen and the hard disk and by slowing the processor down to 8 MHz. Extra batteries cost $99.

In the PC Magazine Labs Battery Rundown test, the 1100LX's battery lasted 2 hours 23 minutes—almost, but not quite, bearing out the vendor's claim. On our other benchmark tests, the machine performed somewhat inconsistently. In each suite of tests—processor, disk, and video—at least one score was above average and one was below average.

Acer offers no other hard disks for the 1100LX, so its standard 40MB Conner disk will have to suffice. You can add an external 1.2MB 5.25-inch floppy disk drive for a reasonable $117 and can boost the machine's expansion capabilities with a $399 expansion chassis that has one 8-bit and two 16-bit slots. An optional carrying case costs $99.

Acer America sells its machines to distributors, who in turn sell them to dealers and VARs. Acer's standard parts-and-labor warranty is good for one year and includes depot service at any of Acer's 700 authorized service centers in the U.S. Owners of Acer systems can also get free technical support by calling a toll-free telephone number.

Certified as FCC Class B, the AnyWare 1100LX is not the lightest 386SX laptop on the market, but it does offer a fine screen and keyboard, reasonably priced add-ons, admirable battery life, and a competitive street price. Two extra pounds isn't much of an extra load if you need the functionality that comes with it.

BITWISE DESIGNS INC.

Bitwise SportSX

by Bruce Brown

Bitwise Designs' SportSX is just about identical to many other 16-MHz 386SX laptops you'll read about in this roundup. That's because Bitwise is one of six vendors who resells a basic unit designed by Japan-based Sotec. As a result, the SportSX performs on par with the other Sotec-designed machines we evaluated. The major difference here is that since the 11.5-pound (including battery) SportSX comes with a Conner hard disk, it costs a few hundred dollars more. Bitwise also makes some slightly better-than-average service and support promises, such as a money-back guarantee and a loaner if your unit needs repairs.

Bitwise charges $2,995 for the SportSX with 2MB of RAM, a 40MB 25-millisecond Conner IDE hard disk, a 1.44MB Epson floppy disk drive, a 16-shade gray-scale backlit double supertwist VGA LCD, one parallel and one serial port, external floppy disk drive and keyboard ports, and DOS 4.01. Major upgrade options include a 106MB hard disk ($495), a 120MB hard disk ($595), a 2,400-bps internal send-fax modem ($275), an extra battery ($100), and a carrying case ($45).

Inside the SportSX's 2.5- by 12.5- by 12.3-inch case is a Sotec motherboard with a 386SX chip set and an AMI BIOS,

Bitwise SportSX, $2,995.

which run the system at either 8 or 16 MHz. The BIOS supports both video and system BIOS shadowing in RAM; you use a keyboard toggle to enable or disable the system BIOS shadowing and the included software to control video BIOS shadowing. The motherboard has a socket for a 16-MHz 80387SX math coprocessor.

The system accommodates a maximum of 6MB RAM, all of which sits on the motherboard and takes the form of 100-nanosecond, page-mode 1MB SIMMs. Since the machine uses standard SIMMs, Bitwise doesn't sell memory upgrades for the SportSX. You should be able to buy memory upgrades from many sources for $100 per MB.

A Gemini video BIOS and a Seiko Epson video chip set drive the SportSX's VGA display. You can attach an external VGA monitor to the laptop through its 15-pin analog VGA port, but you can't run both displays simultaneously. The internal LCD screen has two tubes for sidelighting and uses double supertwist LCD technol-

FACT FILE

Bitwise SportSX
Bitwise Designs Inc., 701 River St., Troy, NY 12180; 800-367-5906, 518-274-0755.
List Price: With 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, 16-shade backlit VGA display, DOS 4.01, $2,995.
Options: 106MB hard disk upgrade, $495; 120MB hard disk upgrade, $595; 2,400-bps send-fax modem, $275; extra battery, $100; carrying case, $45.
In Short: The SportSX costs a few hundred dollars more than the other Sotec-designed 16-MHz 386SX machines reviewed in this roundup, but it comes with the more familiar Conner hard disk rather than Sotec's standard Alps disk. This system is also backed by somewhat better-than-average service and support policies. Performance is on a par with the other machines in this class.

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ogy with pretty good results. Of course, the screen is not as sharp as those using triple supertwist technology.

The 85-key Bitwise keyboard has 12 function keys, 8 dedicated cursor keys, and an embedded numeric keypad. The keyboard feels fine, but it takes time to get used to the inconvenient placement of the cursor control keys at the top of the keyboard. If you find the keyboard bothersome, you can replace it with an AT-style keyboard via the standard port.

The SportSX's 1.8-pound AC adapter/battery charger is large, measuring 5.3 by 3.3 by 8 inches. The machine's internal rechargeable battery has a rated life of 2.5 hours, but the system lasted only 2 hours 10 minutes on the PC Magazine Labs Battery Rundown test. Charging a fully discharged battery takes 8 hours with the system on and 3 hours with the system off. You can extend the life of the battery by using screen, disk, and CPU power-down utilities.

Bitwise sells the SportSX via mail order and through dealers. The SportSX, certified FCC Class B, comes with a one-year parts-and-labor warranty and a 30-day money-back guarantee. If a user-replaceable part fails during the warranty period, Bitwise will advance-ship the replacement component; otherwise you must send the machine to the vendor for repair. If necessary, Bitwise will lend you a machine free of charge while your system is being repaired at the factory.

If 2-hour battery life, a decent VGA LCD screen, a 40MB hard disk, and a 1.44MB floppy disk drive packaged within 13 pounds of machine (with battery and charger) for a little more than $3,000 sound good, then the Bitwise SportSX is a contender. Other vendors sell the same machine for less, but not all offer the same level of service and support.

BUS COMPUTER SYSTEMS INC.

Bus LT-386sx

by Greg Pastrick

If the Bus LT-386sx looks familiar, it's because the Sotec-motherboard machine it's based on is marketed under different names by Bitwise, CompuAdd, Hyundai, Network, Peregrine, and Tangent. This version has no surprises: It's the same 16-MHz 80386SX-based laptop with 2MB of RAM, a 40MB Alps hard disk, a 1.44MB floppy disk drive, a VGA LCD, parallel and serial ports, expansion port, external video and drive connectors, and DOS 4.01.

Bus Computer Systems offers its 11-pound portable for $2,764. The model delivered for review included a 2,400-bps MNP 5 fax/modem card ($250), and an extra battery ($80), which boosted the price for this unassuming system to $3,094. Bus offers few options for the LT-386sx, but they are reasonably priced selections. An external 5.25-inch floppy disk drive with a cable costs $225. Add another $150 for *Microsoft Windows* 3.0 and a mouse.

Bus LT-386sx, $3,094.

Inside the laptop's 2.5- by 11- by 12-inch case is a Sotec motherboard that contains a socket for a 16-MHz Intel 80387SX math coprocessor. Chips and Technologies contributes the chip set; AMI, the BIOS. The LT-386sx's processor is a CMOS 80386SX chip that you can set to run at 8 or 16 MHz.

In our evaluation unit, the 2MB of system memory took the form of two 1MB 80-nanosecond SIMMs on the motherboard. If you need more memory, you can expand that to 4MB ($150) or 6MB ($300).

The LT-386sx's supertwist backlit LCD screen offers a maximum pixel resolution of 640-by-480 and supports 16 shades of gray. The 5.5- by 7-inch screen, driven by a Gemini video chip set, has ordinary brightness and contrast, and its character formation is adequate.

In the PC Magazine Labs benchmark tests, the VGA display yielded slow scores that were in keeping with those of its other-label compatriots. And, with the exception of its 40MB Alps hard disk, which clocked a relatively fast time on the PC Labs BIOS Disk Seek test, the LT-386sx's performance was mediocre.

The LT-386sx's 85-key keyboard lacks the convenient "inverted T" layout for its cursor keys, but it has a good feel to it and types easily, producing a slight click. If you prefer to use a standard AT-style keyboard, you can attach one through a plug on the back of the laptop.

Bus claims a battery life of 3 hours for the LT-386sx's nickel cadmium battery pack; in our Battery Rundown tests, the battery lasted for 2 hours 2 minutes. To help prolong battery life, the LT-386sx comes with power-saving shut-down features for the screen, disk, and CPU that are

FACT FILE

Bus LT-386sx
Bus Computer Systems Inc., 135 West 26th St., New York, NY 10001; 800-451-5279, 212-627-4485.
List Price: With 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 4.01, $2,764.
Options: 2MB RAM upgrade, $150; 4MB RAM upgrade, $300; 2,400-bps, MNP 5 fax/modem card, $250; extra battery, $80; AC adapter, $80; external 1.2MB floppy disk drive, $225.
In Short: Bus's 16-MHz, 386SX laptop compares almost identically to the five other Sotec-based systems in this review. A no-frills system that weighs 11.4 pounds, the Bus LT-386sx has a fair display, slightly awkward keyboard layout, and an average battery life of about 2 hours.

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enabled through CMOS setup and utility programs.

In all, the Bus LT-386sx is a no-frills system that costs about as much as similarly configured Sotec-based machines distributed by other vendors. The differences between these 80386SX-based laptops are measured in options and dollars rather than seconds and milliseconds.

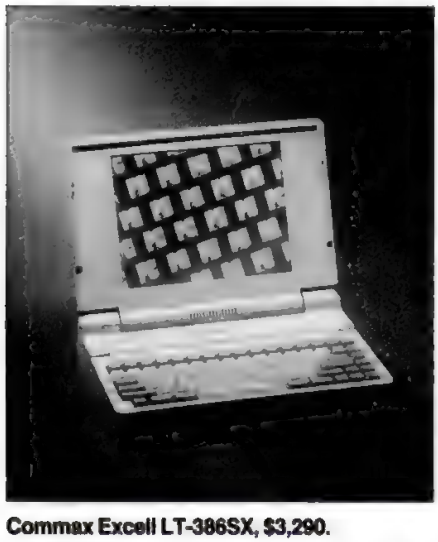
COMMAX TECHNOLOGIES INC.

Excell LT-386SX

by Bruce Brown

Commax Technologies' 16-MHz Excell LT-386SX may not be one of the more familiar laptops around, but its standard features, variety of reasonably priced accessories, and decent list price earn the 12-pound machine more than a quick look.

Selling for a base-configuration list price of $3,195 (about $2,500 through dealers), the Excell LT-386SX comes with 1MB of RAM, a 40MB 25-millisecond Conner hard disk, a 1.44MB internal flop-



Commax Excell LT-386SX, $3,290.

py disk drive, DOS 4.01, a VGA display, one parallel and two serial ports (plus ports for an external keyboard, floppy disk drive, a VGA monitor, and an expansion chassis), and a carrying case (a carrying case comes standard with all systems). Our evaluation unit came with 2MB of RAM and lists for $3,290.

Housed in the Excell LT-386SX's 3.5- by 13- by 9.5-inch case is a Twinhead motherboard that uses a Chips and Technologies chip set and a Phoenix BIOS. The BIOS supports both video and system BIOS shadowing, either of which can be disabled through the CMOS setup program. Also on the system board is a socket for an 80387SX math coprocessor.

The Excell LT-386SX's memory maximum is 4MB, all of which is installed directly on the motherboard in 80-nanosecond 1MB DRAM SIMMs. Commax Technologies sells memory upgrades for $90 per 1MB.

The 8.3 by 6.3-inch sidelit LCD screen uses cold-cathode fluorescent-tube technology and a Cirrus Logic chip set to support up to 32 shades of gray. The system will support SuperVGA on an external monitor, which connects to the Excell via its standard 15-pin analog port. You cannot run the internal and the external display simultaneously.

Accompanying the Excell LT-386SX is an 82-key Alps keyboard that has ten function keys, eight dedicated cursor keys, and a 24-inch cable. In case you prefer a standard full-size keyboard, the machine has a PS/2 keyboard port.

The Excell's 1.6-pound AC adapter/battery charger measures 2.3 by 3 by 6.5 inches, adding little weight or bulk to the system. If you run the Excell on its internal nickel cadmium battery you can expect reasonably long operating times. In our tests, the battery-driven laptop ran for 2 hours 4 minutes without using its hard disk power-down feature.

You can conserve battery power by using a standby button to blank the screen or power down the CPU. Recharging the battery takes 7 hours when the system is off and 7.5 to 8 hours with it running. If you're going to use battery power often you might consider buying the $49 optional external battery charger and one or more extra batteries at $99 each.

You can add an external floppy disk drive to the Excell in two ways: The most usual is to plug a $249 external 1.2MB drive directly into the floppy drive port. However, if you also want to add a standard interface card, you can get a $410 expansion chassis that contains both a 1.2MB floppy disk drive and a single 16-bit expansion slot. And if the standard 40MB hard disk drive doesn't supply enough storage for your needs, you can get an 80MB hard disk for $480 or a 120MB drive for $550. Two other notable options are a $140 car battery adapter and a $199 2,400-bps internal modem.

The Excell LT-386SX, sold through dealers and VARs, comes with a standard one-year parts-and-labor warranty. To obtain service you must return the system to your dealer. Commax Technologies goes an extra step in supporting its machines by extending a 30-day money-back guarantee to users—an unusual offering for computers sold through dealers.

FACT FILE

Excell LT-386SX
Commax Technologies Inc., 2031 Concourse Dr., San Jose, CA 95131; 800-526-6629, 408-435-5000.
List Price: With 1MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 4.01, carrying case, $3,195.
Options: 1MB RAM upgrades, $95; 80MB hard disk upgrade, $480; 120MB hard disk upgrade, $550; 2,400-bps internal modem, $199; extra battery, $99; car battery adapter, $140; external battery charger, $49; external 1.2MB floppy disk drive, $249; expansion chassis $410.
In Short: Standard brand-name parts, a variety of reasonably priced add-ons, and a decent list price distinguish this 12-pound, 16-MHz 386SX laptop. Bigger than a notebook but reasonably compact, this system still provides moderate comfort for travel. It's worth more than a passing glance.

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The Commax Excell LT-386SX works well, has a fine screen, and accepts a variety of reasonably priced add-ons. Overall, its performance on the PC Magazine Labs benchmark tests fell within the normal range for this class of machine, with high scores on processor and video tests. Assuming that the computer's size and weight suit your needs, its price is certainly right.

COMPAQ COMPUTER CORP.

Compaq LTE 386s/20 Model 30

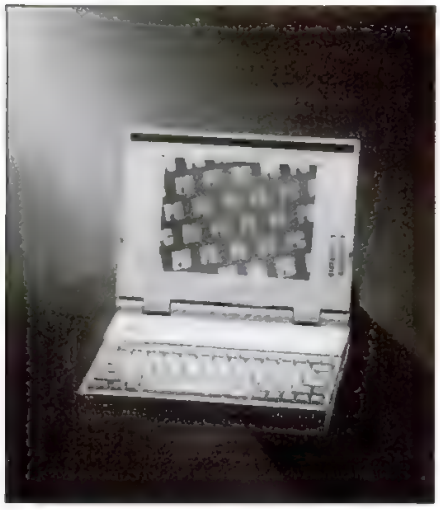
by Greg Pastrick

If you want the best, you have to pay for the best. The $6,499 Compaq LTE 386s/20 Model 30, a 20-MHz 80386SX-based notebook, is no exception to this rule.

Weighing 7.8 pounds and measuring 2.3 by 11 by 8.5 inches, the Model 30 comes with 2MB RAM, a 19-millisecond 30MB hard disk, a 1.44MB floppy disk drive, a sidelit supertwist nematic VGA LCD, one parallel and one serial port, a mouse port, and connectors for an external display, keypad, and docking station as

well as a unique facility for adding RAM with playing-card-sized memory cards.

Premium pricing gets the goods, though. As delivered for review, the Model 30 included a 2,400-bps, MNP 5, V.42 bis-compatible modem ($599), an 80387SX math coprocessor ($999), DOS 4.01 ($150), and 1MB of extra RAM on a 3.3- by 2.1-inch Seiko/Epson memory card ($549) for a total price of $8,796.



Compaq LTE 386s/20 Model 30, $8,796.

Naturally, performance has its cost, but if it's performance you need, the LTE Model 30 will fit the bill—no matter the size of the bill. The LTE 386s/20 was a top performer on PC Magazine Labs' Conventional Memory, DOS File Access, and BIOS Disk Seek tests; it also scored high on the Direct to Screen, Video BIOS, and processor tests.

Inside the LTE 386s/20, all the essential components are surface-mounted to a folded system board constructed of rigid and flexible materials that significantly reduce the original board size. Compaq attributes the technology called REGAL Flex (Rigid Epoxy Glass Acrylic Laminate) to Teledyne Industries. The 20-MHz 80386SX processor gets help from a 4K RAM cache, and the 2MB maximum of system RAM mounted there can be boosted to 10MB total by simply putting 1MB and 4MB RAM cards into a covered card slot compartment on the left side of the notebook. Each 4MB RAM upgrade costs $2,199.

The LTE includes an internal power supply for converting AC power; it comes standard with a 1-pound AC adapter and a 1.8-pound nickel cadmium battery pack that measures 1.3 by 2.9 by 5.8 inches. The LTE's battery, which slides into a bay on the right side of the machine, lasted 2 hours 44 minutes during PC Magazine Labs' Battery Rundown test.

The 640-by-480 resolution display has

PC MAGAZINE FACT FILE
EDITORS' CHOICE

Compaq LTE 386s/20 Model 30
Compaq Computer Corp., 20555 State Highway 249, Houston, TX 77070; 800-231-0900, 713-370-0670.
List Price: With 2MB RAM, 30MB hard disk, 1.44MB floppy drive, VGA LCD, DOS 4.01, $6,649.
Options: 1MB RAM upgrade, $549; 4MB RAM upgrade, $2,199; error-correcting 2,400-bps modem, $599; 80387SX math coprocessor, $999; extra battery, $169; AC adapter, $199; expansion chassis, $1,499; numeric keypad, $119; external storage module, $399; carrying case, $89.
In Short: Price considerations are always important, but the functionality, performance, and expansion possibilities of the LTE 386s/20 are the best justifications for this superior notebook's place in business and industry.

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With SmartPrint, it's as though each computer has its own printer. SmartPrint allows several computers to share any printer automatically. It operates transparently, so you work exactly as before.

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PSS-P6	6	Parallel	$229
PSS-S4	4	Serial	$199
PSS-S6	6	Serial	$229

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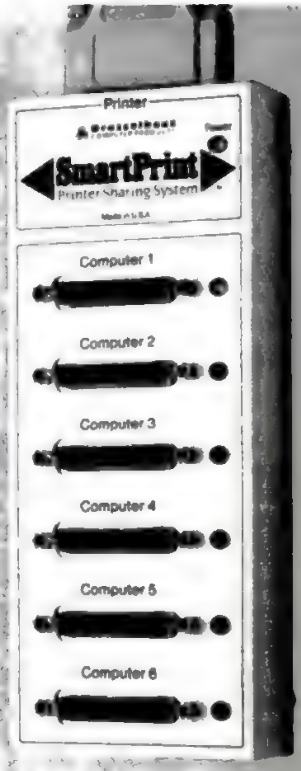
Rancho Cucamonga, CA 91730
(714) 945-5600/FAX: (714) 989-2436



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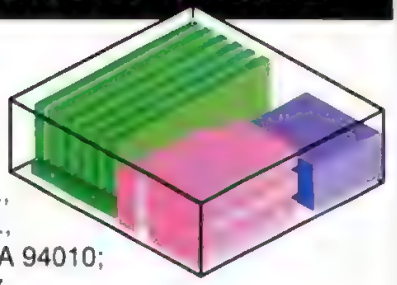
CIRCLE 150 ON READER SERVICE CARD

A Winner.

We didn't say it. PC Magazine did.

FACT FILE

EDITORS' CHOICE



Tangent 386SX/20
Tangent Computer, Inc.,
303 Beach Rd.,
Burlingame, CA 94010;
(800)223-6677,
(415) 342-9388.

List Price: With 1MB RAM, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, one parallel and two serial ports, VGA monitor, $1,644; with 2MB RAM, 60MB hard disk, DOS 4.01, $2,278; with 105MB hard disk, $2,384.
In Short: An excellent contender with above-average electronics and hard-working peripherals, the Tangent 386SX/20 adds an FCC Class B certification to the pile to make it an extremely attractive computer for either home or office.

Standard Configuration:
- Intel 20 MHz 80386SX CPU **$2295**
- 2 MB of Memory (to 8 MB)
- 105MB 17ms Quantum Hard Disk
- Orchid ProDesigner IIe SuperVGA Card
- 14" SuperVGA Color Monitor
- Small Footprint Case w/200W Power Supply
- 5.25" or 3.5" High Density Floppy Drive
- Coprocessor Socket
- One Parallel, Two Serial, One Game Port
- 101-key Enhanced Keytronics Keyboard
- One-year Warranty with On-site Service

PC MAGAZINE
EDITORS' CHOICE
November 27,1990
Tangent 320S

"The 20 MHz 80386SX is the new entry-level business system of choice, starting right now."
PC Magazine

Best choice of the best choices.
Here's how PC Magazine summed up the Tangent 386™SX/20 (Tangent's Model 320s):

"The Tangent 386SX packs outstanding video, expandability to 8 MB, and plenty of free slots into a nicely reduced-size case. The price is right too. This PC offers a 105 MB hard disk and Orchid's ProDesigner II Super VGA card for a mere $2295. Add in clear documentation and on-site service (with Tangent's one-year warranty) and you have a solid winner."

"The Tangent 386SX/20 is the best of the show; it garnered top scores in all of our video tests."

A system with a future. The Tangent 386SX/20 runs all of yesterday's programs. All of today's. And most important, tomorrow's. Because it implements the full Intel 80386 feature set.

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PC Magazine's windup: *"Add an FCC Class B rating and a one-year warranty on parts and labor that includes on-site service into the bargain, and you begin to suspect that the Tangent 386SX/20 is a winner. Consider the price/performance ratio of the computer and that suspicion starts to look like a certainty."*
Bill O'Brien, PC Magazine, 11/27/90

Thanks Bill. We couldn't have said it better.

Order now, Toll Free:
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COMPUTER

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Phone: 415/342-9388 FAX: 415/342-9380

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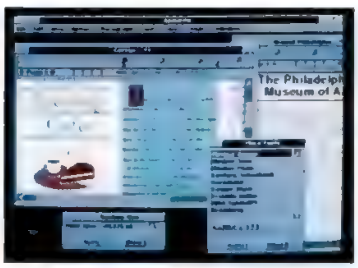
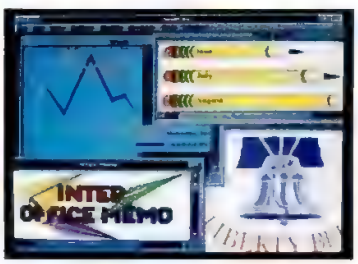
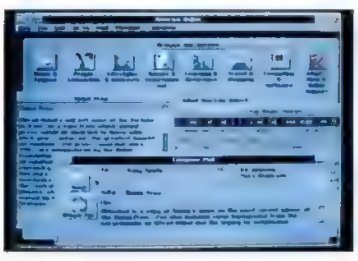


Word Processor



Graphics



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CIRCLE 252 ON READER SERVICE CARD

a decent-sized 5.5- by 7.2-inch screen but is not as bright and crisp as others we reviewed, even when reversed to black on white. It is, however, highly readable and produces 16 shades of gray.

The feel of the keys on the 81-key keyboard is solid; each key is full-sized and appropriately spaced. Twelve function keys are easily reached across the top; the left-hand Fn key is large; and the embedded numeric keys are clearly labeled. The LTE's standby button, status LEDs, and sliding power switch line up neatly above the keyboard to the left. But unless you've been weaned on Compaq LTEs, adjusting to the "L" shaped cursor key arrangement takes time.

Compaq's optional 5.5- by 13.5 by 16-inch desktop expansion chassis augments and replaces the LTE's existing ports and device interfaces. With its own built-in power supply, the docking station has room for two full 8- or 16-bit expansion slots, an additional floppy disk drive, a tape drive, one parallel and one serial port, and connections for alternate input devices, an external monitor, and a keyboard adapter. When docked, the LTE can serve as a full-functioning desktop once all the right accessories are attached.

Price considerations are always important, but the LTE 386s/20's functionality, performance, and expansion possibilities justify its place in business and industry.

COMPAQ COMPUTER CORP.

Compaq SLT 386s/20 Model 60
Compaq SLT 386s/20 Model 120

by Edward Mendelson

If you need more capacity than Compaq's notebook-size LTE 386s/20, consider Compaq's SLT 386s/20. This system won Editors' Choice five months ago ("Power Portables: The Next Wave," *PC Magazine*, October 16, 1990), and it retains Compaq's characteristic high-speed performance, high-tech engineering, and high-quality finish. Like the LTEs/20, it also has Compaq's characteristic high price.

The SLT 386s/20 Model 60, with 2MB of RAM, a 60MB hard disk, a 1.44MB floppy disk drive, and a VGA monochrome liquid crystal display, supercharged with 4K of processor RAM cache and DOS 4.01, costs $6,919.

Compaq SLT386s/20 Model 120, $7,649.

With a machine this powerful, you'll want acres of disk space, and you should probably start with the Model 120, which has a 120MB hard disk and DOS 4.01, and costs $7,649. As tested by PC Magazine Labs, the 14-pound Model 120, with an i387SX math coprocessor and extra 2MB of RAM, will set you back $9,647.

The gray plastic case of the Compaq SLT series measures 4.1 by 8.5 by 13.5 inches—more compact than most other laptops in this powerful class. That trim case conceals some highly advanced engineering. The snap-in battery gives almost 2.5 hours of computing time even with 4MB of RAM installed—longer than virtually all the competition—and the supplied AC adapter adds little weight or inconvenience when you travel. Beeps and LED indicators give you plenty of warning before the battery gives out. A standby button lets you put the system in temporary cold storage, and an adjustable timer will turn off the disk and display after a specified period of inactivity.

The SLT 386s/20 has the power and speed of a fast desktop machine, but to give it expansion possibilities that approach a desktop unit's, you'll need Compaq's $999 self-configuring expansion base, which provides two full-length 16-bit card slots. You can also attach an external VGA monitor. You can't use the external and internal monitors at the same time, but a keystroke lets you switch between them instantly.

You may want an external monitor because the internal one, though brightly backlit, has a slight haziness that keeps it from living up to the quality of the rest of the machine. If you're unhappy with the way the video display works in your current lighting environment, you can switch with one keystroke from the default display setting of dark characters on a light background to a reverse video setting of light characters on a dark background.

The detachable 82-key keyboard has Compaq's characteristically spongy feel and a somewhat complex arrangement. Four small arrow keys in the front right corner double as PgUp, Home, End, and PgDn when you hold down the Fn key. NumLock turns on the keypad embedded in the alpha keys. The Fn key enables the cursor-movement functions in the embedded keypad.

If the standard 2MB of RAM on the SLT 386s/20 isn't enough, prepare for sticker shock. A 1MB RAM upgrade costs $549, a 2MB upgrade costs $999, while a 4MB upgrade, at $2,199, costs even more per megabyte than the 2MB upgrade. You can fit up to three of Compaq's proprietary memory boards into slots on the motherboard, for a total of 14MB of RAM in the system.

Included with the Compaq SLT

FACT FILE

Compaq Computer Corp., 20555 State Hwy. 249, Houston, TX 77070; 800-231-0900, 713-370-0670.

Compaq SLT 386s/20 Model 60
List Price: With 2MB RAM, 60MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 4.01, $6,919.
Options: 1MB RAM upgrade, $549; 2MB RAM upgrade, $999; 4MB RAM upgrade, $2,199; desktop expansion chassis, $999; 2,400-bps modem, $599; extra battery, $129, carrying case, $89.
In Short: This is a beautifully engineered portable with long battery life and some brilliant design touches. The keyboard has tiny cursor keys and is more spongy than those on some other portables, and the screen is a bit hazy, but these are trivial complaints about a championship machine.

CIRCLE 549 ON READER SERVICE CARD

Compaq SLT 386s/20 Model 120
List Price: With 2MB RAM, 120MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 4.01, $7,649.
Options: See above.
In Short: For disk space that far exceeds that of Compaq's notebook portable, the SLT 386s/20 Model 120 is the right choice.

CIRCLE 550 ON READER SERVICE CARD

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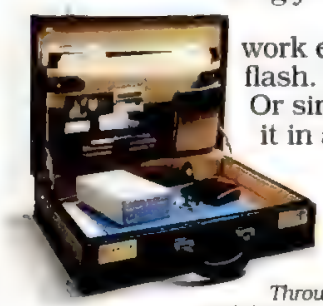

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MTBF (Hours)	**60,000**	<25,000	60,000
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CIRCLE 317 ON READER SERVICE CARD

386s/20 are Compaq's disk-caching and expanded-memory-manager software as well as a highly detailed diagnostic and system-reporting utility. As is customary with Compaq computers, you get every possible luxury with the SLT 386s/20, but at a luxury price.

COMPUADD CORP.

CompuAdd 316SL

by Bruce Brown

CompuAdd Corp. has grown to be one of the country's largest mail-order vendors by selling standard computer equipment at competitive prices and backing its wares with excellent service. Standard is an apt description for the vendor's 16-MHz 386SX-based CompuAdd 316SL, which is the same Sotec-designed machine sold by several other computer resellers and which yielded the same or very similar results to other Sotec-based machines on PC Magazine Labs' benchmark tests.

In its standard configuration, the 316SL sells for $2,895 and includes 2MB of RAM, a 40MB 19-millisecond Alps hard disk, a 16-shade sidelit double supertwist VGA liquid crystal display, one parallel and one serial port, a 3.5-inch 1.44MB Epson floppy disk drive, an 85-key keyboard, video ports, DOS 4.01, *Microsoft Windows* 3.0, *DOS Help!*, *LapLink II*, a carrying case, and a CompuAdd serial mouse. CompuAdd sells 1MB RAM upgrades for $99, a 2,400-bit-per-second internal fax-send modem for $249, an external 1.2MB floppy disk drive for $215, and extra internal batteries for $65.

CompuAdd 316SL, $2,895.

The CompuAdd 316SL measures 2.5 by 12.5 by 12.3 inches and weighs 11.5 pounds with its 12-volt rechargeable nickel cadmium battery; the 1.8-pound AC adapter/battery charger brings the total weight of the machine to just over 13 pounds. The nickel cadmium battery is rated to last 2.5 hours and takes 8 hours to recharge with the system running or 3 hours with the power off. You can set the AMI BIOS to slow the system to 8 MHz after a set interval of inactivity, and you can use standard software to set screen-blanking and hard disk power-down intervals to conserve battery power further.

On our Battery Rundown test, we found the CompuAdd's 1-hour-52-minute battery life to be somewhat shy of the other Sotec systems', an anomaly that should be attributed to sample error since the battery in this machine is the same as that in other

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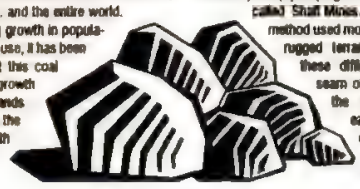
THE FACTS ABOUT

COAL

Coal is derived from the tissues of plants that flourished several hundred million years ago in swamps. As generations of plants grew and died, their debris accumulated as peat until in many areas it was several feet thick. Such areas sometimes subsided for long periods beneath shallow seas. Sediments settling on the sea bottom formed sandstones and other sedimentary rocks; their weight compressed the peat and converted it into coal. This cycle might be repeated several times, forming layer upon layer of fresh peat material.

Coal is by far the most abundant fossil fuel, both in the U.S. and the entire world. With continuing growth in population and energy use, it has been speculated that this coal could meet the growth in energy demands all the way until the year 2000, with reserves for 150 years.

Coal has been used frequently by man since prehistoric times, but coal mining itself did not become a major industry until the late eighteenth century and the industrial revolution. Today, there are four types of coal mining procedures mainly used within the U.S. and other countries. Coal that lies sufficiently near the surface is simply Surface Mined by removing the overlying layers of rock. A Slope Mine is utilized when the coal seam lies at moderate depths. An opening that slopes gently permits easy haulage from this mine. Coal that lies deep beneath the ground is reached by steeply sloping or vertical openings called Shaft Mines. Drift Mining is a method used mostly in tough and rugged terrain. In many of these difficult cases, the seam of coal lies along the surface of the earth, completely cut in the open, and can thus be mined directly.



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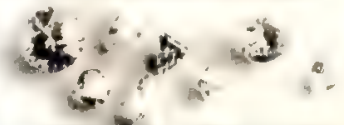

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The most important localities for diamonds have been in India, where they were mined from the earliest times until the close of the 18th century, South America, where they have been mined since the middle of the 18th century, and South Africa, to which almost the whole diamond mining industry has been transferred since 1870.

CHARACTERISTICS

A diamond is almost always found in single crystals, which show no sign of previous attachment to any matrix; the stones were, until the discovery of South American mines, almost entirely derived from sands or gravels, but owing to the hardness of the mineral it is rarely, if ever, waterworn.

Some famous diamonds

Florentine
This pale yellow diamond was acquired in the early 17th century by the Duke of Tuscany and later became one of the Austrian crown jewels.

Koh-i-noor
The "Mountain of Light" gem has the oldest recordable history of all diamonds and has been traced back to 1304. Purchased by the British in 1849, it now is in the Queen Mother's crown.

Jubilee
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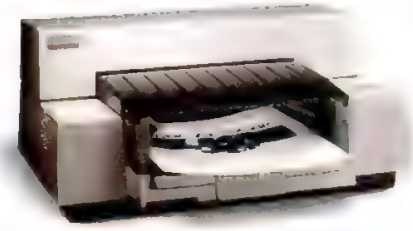
But you don't know there is an alternative to the loud dot matrix arena. Which means your documents don't look as good as they deserve to look.



Enter the new, improved HP DeskJet 500 printer. At just $729, it's a gem. The 300 dpi inkjet technology makes your output look beautiful. Sharp and compelling. And our new water-resistant ink makes sure it stays beautiful.

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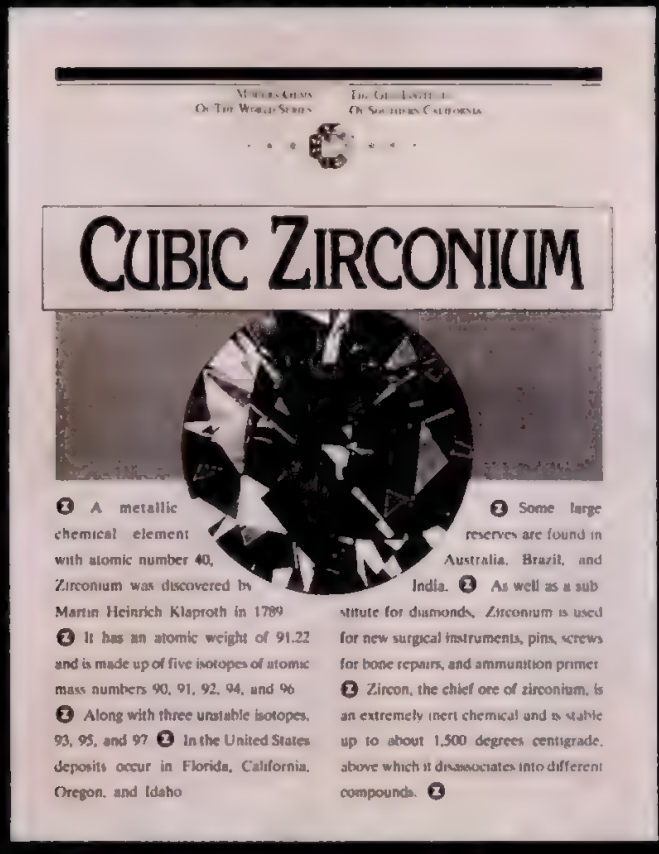
Great looking price.

New HP DeskJet 500 printer $729.*



comes with a lot of high-end features. Multiple fonts. Scalable type up to 127 points through Windows support. Portrait for letters or landscape for spreadsheets.

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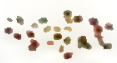

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CIRCLE 179 ON READER SERVICE CARD

Sotec computers and the same charging and power features were used in testing all the computers. The system preserves some of its power by shutting down the display and disk when idle.

The 316SL's motherboard and 386SX chip set are manufactured by Sotec. The AMI BIOS offers system BIOS shadowing. Video BIOS shadowing is also available through the included video utility software. There is no password control in the BIOS, but the setup control program is in ROM for easy updating or reconfiguring.

The Sotec motherboard has a socket for an 80387SX math coprocessor. You can install a maximum of 6MB of page-mode RAM on the systemboard using 100-nanosecond 1MB SIMMs.

The coming onslaught of 386SX notebook machines with 40MB hard disk drives may threaten the lifespan of 10-pound plus laptops like the CompuAdd 316SL. This machine offers good functionality at a decent price.

The 7- by 5.3-inch display uses double supertwist LCD technology with double-tube sidelighting. This type of screen was state-of-the-art a year or two ago, but today it has to take a seat behind triple supertwist LCD screens, such as those on the Acer AnyWare 1100LX laptop and the CompuAdd, Sharp, and Texas Instruments 286 notebook machines. If you're going to run graphics applications, you may want a better screen than that of the CompuAdd.

The 316SL's 85-key keyboard has four dedicated cursor control keys, 12 function keys, and an embedded numeric keypad. There's no unshifted asterisk key, and the cursor keys are somewhat inconveniently located at the top right of the keyboard. Overall, the keyboard is pretty good, but it takes getting used to.

CompuAdd sells the 316SL via mail order and through its own chain of retail stores. The standard one-year parts-and-labor warranty is backed by toll-free technical support, one-way paid shipping for in-warranty repairs at the vendor's Texas location, and a 30-day money-back guarantee.

The coming onslaught of 386SX notebook machines with 40MB hard disk drives may threaten the lifespan of 10-pound-plus laptops like the CompuAdd 316SL. But if you don't mind the weight and need a machine now, this one offers good functionality at a decent price.

FACT FILE

CompuAdd 316SL
CompuAdd Corp., 12303 Technology Blvd., Austin, TX 78727; 800-327-1967, 512-250-1489.
List Price: With 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 4.01, *Microsoft Windows* 3.0, *DOS Help!*, *LapLink II*, CompuAdd mouse, carrying case, $2,895.
Options: 1MB RAM upgrade, $99; internal 2,400-bps fax-send modem, $249; external 1.2MB floppy disk drive, $215; extra battery, $65; extra carrying case, $55.
In Short: CompuAdd distinguishes its version of the Sotec-designed 16-MHz 386SX laptop by including a mouse, software, and a carrying case as standard. The familiar brand name and support policies might persuade you to buy this laptop from CompuAdd instead of another vendor, but you'll get the same, fairly run-of-the-mill 11-pound system.

CIRCLE 601 ON READER SERVICE CARD

DELL COMPUTER CORP.

Dell 316LT
Dell 320LT

by Edward Mendelson and M. David Stone

The Dell 316LT and 320LT are two of the sleekest-looking and sleekest-performing clamshell-shaped laptops you're likely to find. As a bonus, both have some of the cleverest of today's power-management design.

Dell's prices are sleek, too. In its basic configuration, which includes a 16-MHz 80386SX processor, 1MB of RAM, a 20MB hard disk, a 1.44MB floppy disk

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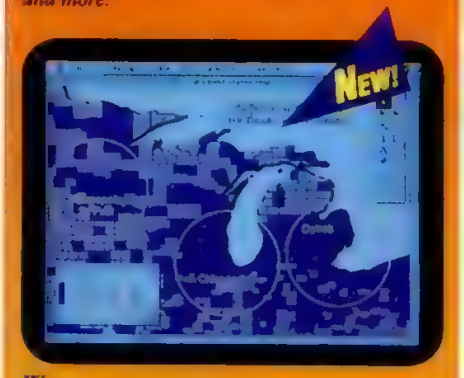

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CIRCLE 291 ON READER SERVICE CARD

Dell 316LT, $4,176.

drive, and DOS 3.3, the Dell 316LT costs $3,099. Even as tested by PC Magazine Labs, with 2MB RAM, a 40MB hard disk, an 80387SX coprocessor, a fax/modem, and DOS 4.01, the $4,176 price is easy to live with.

The 320LT costs $3,899, with 2MB of RAM, a 40MB hard disk, a 1.44MB floppy disk drive, a VGA display, and DOS 3.3. The unit Dell sent for review had an 80387SX in the coprocessor socket and a combination fax/data modem in the proprietary modem slot. At $399 for each of these options, the price of our tested configuration was $4,697.

If you want a basic laptop, the 316LT compares favorably in price with other 16-MHz portables in this roundup. If you have the extra money and want a real performer, go for the loaded 320LT; it shaves nearly a second off PC Magazine Labs' Instruction Mix test, and shows speed gains across the board.

FACT FILE
EDITORS' CHOICE

Dell 316LT
Dell Computer Corp., 9505 Arboretum Blvd, Austin, TX 78759-7299; 800-426-5150, 512-338-4400.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB floppy drive, VGA display, DOS 3.3, $3,099.
Options: 1MB upgrades, $100; upgrade to 40MB hard disk, $200; 2,400-bps modem, $399; upgrade to DOS 4.01, $19; math coprocessor, $359; ethernet adapter, $199; car battery adapter, $100; single extra battery pack, $80; two pack, $129.
In Short: Dell's 16-MHz 386SX clamshell is a clear winner, with excellent performance, a fine keyboard, a sharp display, and sophisticated battery design all in its favor.

CIRCLE 603 ON READER SERVICE CARD

LADEN WITH FEATURES

At 15 pounds, without the spare battery or AC adapter, the Dell 316LT and 320LT barely survive the cut for inclusion in this overview. The units are also a bit large for the average lap, at 3.5 by 12.8 by 14.3 inches.

Still, neither system is too much to lift when you consider its power and features. When you use the backlit, supertwist VGA display, you'll probably be delighted by its fast response time. You can toggle between the built-in display and an external VGA monitor with a keystroke. Equally impressively, the display detaches from the main body, so you can slip the system under a monitor stand and plug a monitor into the high-density 15-pin port on the back. According to Dell, the unit supports VGA or Super VGA external monitors, and will support software written for MDA or Hercules modes.

When you type on either machine,

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Say you need a printer for the office. One that's fast and reliable. Say price is no object. Well, almost no object. May we suggest the versatile NEC Pinwriter® P3300. It's a snap to operate. Just choose one of the seven resident font styles, a pitch, a print mode, and go. In a real hurry? Try Quick Gothic for letter-quality output at 90 characters per second. Whatever you print, from single

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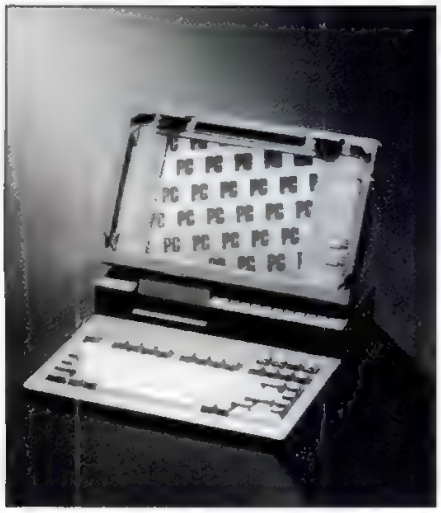
C&C Computers and Communications



Dell 320LT, $4,697.

you'll be delighted by its firm and responsive 83-key keyboard, complete with large function keys and a clearly defined set of cursor keys laid out in standard formation. You don't get a separate keypad, but a reasonably intuitive key combination, Ctrl-NumLock, turns on a keypad embedded in the alpha keys. If you would prefer to use a full-size keyboard at home base, you will also find that there's a PS/2-style keyboard connector on the back.

Inside the case, Dell made room for a half-length, 8-bit expansion slot and a proprietary slot for a 399 combined modem and fax board. An Ethernet card costs $199, and a car-battery adapter will set you back $100.

HIDDEN BENEFITS

Some of the best features of these two systems are undetectable until you need them. If you're running the unit on battery power instead of its 1.5-pound transformer, you get a healthy 2 hours 11 minutes of battery time on the 316LT and 10 extra minutes on the 320LT, according to PC Magazine Labs' Battery Rundown test. And you don't have to panic when the low-battery-power warning alarm flashes and sounds, first with 30 minutes' warning, then with 10. You don't even have to close down your applications and turn off the machine. You leave the machine on, eject the battery pack from its slot behind the screen hinge, and plug in the spare that comes with the unit. A patented reserve battery inside the machine itself keeps the computer going for up to 3 minutes while you make the switch.

Dell helps you delay the low-power warning by pressing a standby button that turns off the backlit display and the hard disk and lowers the CPU speed to 8 MHz, while preserving power to the processor and RAM. An automatic sleep mode spins down the hard disk after a user-specified interval with no disk accesses, and turns

FACT FILE
EDITORS' CHOICE

Dell 320LT
List Price: With 1MB RAM, 20MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA display, one parallel and one serial port, DOS 3.3, $3,599.
Options: 1MB upgrades, $100; upgrade to 40MB hard disk, $200; 2,400-bps modem, $399; 80387SX math coprocessor, $399; Ethernet adapter, $199; car battery adapter, $100; single extra battery pack, $80; two pack, $129.
In Short: Once you add an adapter and batteries to the Dell 320LT, you'll be carrying a 20-pound system with you. But you will get a bright screen with plenty of contrast and a keyboard that are almost as comfortable to use as the ones on your desktop. The fully configured 320LT is well worth the upgrade from the 16-MHz 316LT.

CIRCLE 604 ON READER SERVICE CARD

The printer to buy if you're spending your own money.

sheets and envelopes to multi-part forms, the P3300 (and the narrow carriage P3200) can handle anything. Now let's say you need a printer for your home. One that's fast and reliable. And let's say price is definitely an object. May we suggest the versatile NEC Pinwriter P3300. All the features you expect. At a price you won't. For more information call 1-800-NEC-INFO.

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CIRCLE 394 ON READER SERVICE CARD

BATTERY-POWERED 386-BASED PORTABLE PCs: SUMMARY OF FEATURES

In each of the features tables for this portables blockbuster issue, the machines are listed in alphabetical order. Use this key for an explanation of the features in each section's table.

Price of standard configuration To facilitate comparison, we are citing prices for similarly equipped machines. The standard configuration for our three *8086*-based portables includes 1MB RAM and DOS 3.3 or 4.01. For our nine *80286*-based machines, we required 1MB RAM, a 20MB hard disk, one 1.44MB floppy disk drive, a display, one parallel and one serial port, and DOS 3.3 or 4.01. For the 20 battery-powered *80386SX*-based portables, we required 2MB of RAM and a 40MB hard disk. For our three *80386*-based battery-powered and five AC-powered machines, as well as our single *80486*-based portable, we required 4MB RAM, a 100MB hard disk, a display, one parallel and one serial port, and DOS 3.3 or 4.01. See each machine's fact file for a more exact indication of what is included at the quoted price.

Distribution channel Some machines are sold directly through mail order. When machines are sold by dealers, the purchaser may find discounts of 25 to 30 percent off the list price (although there is no guarantee that the discounts will run this high).

Display technology indicates the type of display (liquid crystal, gas plasma, or electroluminescent) and the method and location of the illumination. Typical display technologies include cold cathode fluorescent tube (CCFT), supertwist, and triple supertwist nematic (TSTN).

Chip set manufacturer indicates which company makes the logic that connects the CPU with the other functions supported by the system board. Chip sets that use VLSI (very large scale integration) technology reduce the discrete component count, which in turn helps reduce power consumption and increase component life.

The **BIOS version** and **date** can affect PC Magazine Labs' benchmark test results. A machine with a different BIOS may perform differently.

Video shadowing/System shadowing Shadow RAM is a technology that loads system BIOS and/or video BIOS from slower ROM into faster RAM on boot-up. Shadowing uses RAM located between 640K and 1MB.

RAM (minimum–maximum) indicates the amount of memory that can be installed in the unit; this is followed by the amount of **installed RAM** on the machine that PC Labs tested.

RAM packaging (and **rated speed**) Memory chips come in a variety of styles: DIPs, SIPs, ZIPs, and SIMMs.

The *dual in-line package (DIP)* is the traditional computer chip sprouting 8, 14, 24, 40, or more metal legs, evenly divided between right and left sides.

Single in-line packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. They can be individual chips or multiple chips on a small card with a proprietary SIP connection. Similar to SIPs are *ZIPs (zigzag in-line packages)*, in which every other pin connection is slightly offset, creating a zigzag pattern.

Single in-line memory modules (SIMMs) are individual logic devices installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement facilitates easy installation and replacement.

Chip size Kb and Mb refer to kilobits and megabits, respectively (K and MB are used for kilobytes and megabytes). Combination chips (4x256Kb) are generally faster and more expensive.

A **processor RAM cache** acts as a bridge between the CPU and the slower main memory. The cache comprises a small bundle (typically 32K to 128K) of fast static RAM (SRAM) chips. The cache controller is designed to predict and retrieve the data that the CPU is likely to require next, thus preventing wait states. There are two varieties of controllers: discrete logic chips (designed by the individual manufacturers) and VLSI chips like the Intel 82385.

Hard disk capacity and size shows the capacity (in megabytes) and the platter size of the hard disk in the tested configuration. The recently developed 2.5-inch hard disks provide substantial weight and size savings over 3.5-inch disks. At this time, 20MB versions are readily available and 40MB drives are beginning to enter the marketplace.

Interface Within the PC environment, the three most common hard disk interfaces are *ST-506, SCSI (small computer system interface)*, and *ESDI (enhanced small device interface)*. ST-506 uses one of two data encoding methods, *RLL (run length limited)* or the older *MFM (modified frequency modulation)* scheme. Both SCSI and ESDI require special hard disk controllers. *IDE (intergrated drive electronics)* is a relatively new interface that incorporates the controller onto the hard disk and uses RLL encoding. All battery-powered notebook PCs use an IDE interface.

Bus speeds Most PCs and portables run their system (expansion) buses at 8 MHz. Faster speeds may cause compatibility problems with peripherals.

Proprietary expansion slots refers to machine-specific slots; these are most commonly used for modems. Sometimes these slots can also be used for network adapters or fax modems.

Other expansion slot indicates whether the portable can internally accept the standard accessory cards used in desktop PCs. *ISA (Industry Standard Architecture)* is the classic bus design of mainstream PC compatibles. *MCA* refers to Micro Channel architecture

off the backlighting and lowers the CPU speed if you don't enter data for the same interval. You can also save power by disabling the I/O ports, the math coprocessor, and the proprietary fax/modem by pressing a variety of key combinations. Once you do exhaust the battery, it needs eight hours to recharge in trickle mode, but a fast charge option can get it ready for action in two hours.

The back of Dell's black case gives you all the normal conveniences you can expect from a clamshell laptop: a reset button, VGA port, serial and parallel ports, and a connector for an external disk drive.

There's also an expansion-connector port on the unit that doesn't connect to anything right now, but conceivably could be used in the future for a desktop docking station or other external unit.

The Dell 316LT and 320LT give you some of the finest-engineered 80386SX computing you can find on a laptop. Although they're heavy, if you need computing power, either of these laptops may well be worth the weight.

FORA INC.

Fora LP386SX Model 70/20

by M. David Stone

Fora likes to call the LP386SX Model 70/20 a laptop system, but with measurements of 3.3 by 12.8 by 16.3 inches, it's stretching the definition. Given that size, plus a weight of 14.5 pounds, there aren't many laps that the 70/20 will fit on com-

(developed for the IBM PS/2). *EISA (Extended Industry Standard Architecture)* is an extension of ISA.

An external expansion port means that the system bus can be connected to external devices such as an expansion station or external floppy disk drive. (A few older portables may use the parallel port as the expansion connector. This does not pass all the signals of the system bus but is adequate for connecting floppy disk drives.)

An **expansion unit,** also called a docking station or expansion station, provides additional space for standard expansion cards and hard disks, tape drives, or floppy disk drives. Some portables automatically reconfigure to recognize the expansion unit and its contents (**self-configuration**). Some also let you click the unit into place with a single step (**single connection**); others require you to make multiple connections for power, signal, video, and modem.

Video modes supported indicates all common video modes: Super VGA, VGA, EGA, CGA, HGA (Hercules), and MDA (monochrome). Double-scan CGA is a superset of CGA and provides 640 by 400, 640 by 200, and 320 by 200 resolution; while double-scan is better than CGA-only, VGA is preferable.

Gray scales at maximum resolution indicates how many shades of gray the unit can display at its best resolution.

Interface 16-bit video interfaces are typically faster than 8-bit because of their wider bandwidth.

Simultaneous external display A yes answer means that an external monitor can be connected without blanking the portable's flat-panel display. This is useful for small-group demonstrations.

The keyboard section shows the **total number of keys,** the number of **function keys** (10 or 12), and the number of **cursor keys** (4 or 8). If you have only four cursor keys and you need to access PgUp, PgDn, Home, or End, you must hold a function key and tap one of the arrow keys—an inconvenient extra step.

Software The availability and price of DOS 3.3 and 4.01 are listed here. If no price is shown, the base-priced system includes DOS. (*PC Magazine*'s standard configuration includes DOS 4.01—or, if it is not available, DOS 3.3*x*—to allow more accurate price comparisons.) Where OS/2 is available, the version number and list price are given.

Disk caching software buffers, or caches, the most recently read data from the hard disk, resulting in significant speed improvements. You need extra memory (beyond 1MB) for best results.

An **expanded memory manager** is a device driver used to emulate expanded memory in the extended memory of a 286, 386SX, or 386 PC. The most popular expanded memory managers follow the Lotus/Intel/Microsoft (LIM) specification.

Internal modem lists the speed and list price of the vendor's preferred modem. Modems that function at 2,400 bits per second and faster benefit from built-in error correction. *MNP 5 compression* is the most widespread form of data compression in use today; it includes MNP 2 through MNP 4 error correction. *V.42 error correction* is an emerging standard, as is *V.42 bis compression,* which includes V.42 correction. Whenever possible, you should strongly consider MNP 5 compression as a minimum requirement. **Modem options** indicates whether or not the modem includes additional features, such as fax capabilities.

Power supply If the machine is AC-powered, we state the output wattage of its power supply. This specification is important for those who wish to add peripherals.

If a machine has **dual voltage,** a switch (usually automatic) on the power supply permits use with both 110- and 220-volt current.

Claimed battery life is the vendor's rating, in hours, for the internal battery or batteries. PC Magazine Labs independently measures battery life and reports the results in the performance test section. Battery **charge time with unit on,off** shows how long it takes to recharge the machine's batteries with the machine on as well as off.

Shutdown: display/disk and **system/peripherals** involves automatically dimming or blanking the display, turning off the hard disk (now common to most portables), slowing or halting the CPU, and removing power from I/O ports (modem and serial ports) when the machine is not in use.

The **transformer weight** and **size** can vary significantly among machines with similar power needs.

FCC certification class means that an electronic device has sufficiently low radio-frequency (RF) emissions to be used in the home. Portable PCs must have Class B certification.

Vendors sometimes describe a machine as "Class B pending," but the term carries no legal weight.

Every FCC Class B unit has an **FCC identification number.** To verify any system's status, you may dial up the Public Access Link, the FCC's own bulletin board service. The phone number is 301-725-1072.

CONTINUES

fortably. Think of it instead as an oversize laptop with 20-MHz 386SX performance and a highly readable backlit LCD.

The base-priced Model 70/20 carries a suggested list price of $4,499, and $4,699 for *PC Magazine*'s standard configuration. Dealer pricing will probably be far lower. Tangent sells the same system (also reviewed in this section) via direct mail at $2,890 for our standard configuration. Realistically, the street price for the Model 70/20 should be close to Tangent's mail-order price.

As tested, the Model 70/20 included 2MB RAM, a 40MB hard disk, a VGA display, one parallel and two serial ports, and DOS 4.01. The $200 difference between the basic and tested configurations comes from an additional 1MB of RAM. Fora also sells a 4MB RAM upgrade for $600, yielding a maximum system RAM total of 5MB.

According to Fora, the Model 70/20 is a joint design, engineering, and manufacturing project between Fora, Chaplet, and Lung-Hwa. Each company manufactures different parts of the system, with Chaplet responsible for final assembly. Chaplet also builds the system board, which is where you'll find most of the key components.

Included on the Chaplet board are the 80386SX-20, the Chips and Technologies chip set, AMI BIOS, Cirrus VGA video chip set, a socket for an 80387SX, one parallel port, and two serial ports. Oddly, one of the serial ports uses a 9-pin DIN connector meant for a mouse. For those who can't use the DIN connector, Fora also supplies

BATTERY-POWERED 386-BASED PORTABLE PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	386SX-BASED							
	Acer AnyWare 1100LX	Bitwise SportSX	Bus LT-386sx	Commax Excell LT-386SX	Compaq SLT 386s/20 Model 120	Compaq LTE 386s/20 Model 30	CompuAdd 316SL	Dell 316LT
Price of standard configuration	$4 215	$2,995	$2,764	$3,290	$6,919	$6,649	$2,895	$3 399
Distribution channel	Dealers	Dealers, direct	Direct	Dealers	Dealers	Dealers	Dealers, direct	Direct
Microprocessor clock speed	16 MHz	16 MHz	16 MHz	16 MHz	20 MHz	20 MHz	16 MHz	16 MHz
Power supply type	AC, battery	AC, battery	AC, battery	AC, battery	AC, battery	AC, battery	AC, battery	AC, battery
Dimensions (HWD, in inches)	4.1 x 14 x 8.5	2.5 x 12.5 x 12.3	2.5 x 12.5 x 12.3	3.5 x 13 x 9.5	4.1 x 8.5 x 13.5	2.3 x 11 x 8.5	2.5 x 12.5 x 12.3	3.4 x 12.7 x 14.3
Weight (pounds)	13.7	11.4	11	12	14.2	7.7	11.4	15
Display area (WxH, in inches)	8 x 6	7 x 5.3	7 x 5.3	8.2 x 6.2	7.8 x 5.9	7.3 x 5.5	7 x 5.3	7.8 x 5.8
Display technology	Backlit supertwist LCD	Backlit supertwist LCD	Backlit supertwist LCD	Sidelit cold cathode LCD	Backlit supertwist LCD	Sidelit supertwist LCD	Backlit supertwist LCD	Backlit Supertwist LCD
Motherboard manufacturer	Acer	Sotec	Sotec	Twinhead	Compaq	Compaq	Sotec	Dell
Chip set manufacturer	Headland	Sotec	C&T	C&T	Compaq	Compaq	Sotec	Kyocera
Coprocessor installed	None	None	80387SX	None	80837SX	80387SX	None	80387SX
BIOS version	Acer V1.0R2	AMI 1.11	AMI	Phoenix 1.10 20	Compaq	Compaq 386 BIOS	AMI 1.11	Phoenix 1.1A00
Date	July 1989	September 1989	September 1989	January 1988	May 1990	August, 1990	September 1989	May 1990
Video shadowing/System shadowing	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
MEMORY								
RAM (minimum–maximum)	1MB–5MB	2MB–6MB	2MB–6MB	1MB–4MB	2MB–14MB	2MB–10MB	2MB–6MB	1MB–8MB
Installed RAM	3MB	2MB	2MB	2MB	4MB	2MB	2MB	2MB
RAM packaging	SIMM	SIMM	SIMM	SIMM	DIP	Proprietary	SIMM	SIMM
Rated speed	100 ns.	100 ns.	80 ns.	80 ns.	70 ns.	80 ns.	100 ns.	100 ns.
Chip size	1Mb	1Mb	1Mb	1Mb	256Kb	1Mb	1Mb	1Mb
Processor RAM cache installed	None	None	None	None	4K 4-way set associative	4K 4-way set associative	None	None
DISK DRIVES								
Hard disk capacity and size	40MB 3.5-inch	40MB 3.5-inch	40MB 3.5-inch	40MB 3.5-inch	120MB 3.5-inch	30MB 3.5-inch	40MB 3.5-inch	40MB 3.5-inch
Manufacturer	Conner	Conner	Alps	Conner	Compaq	Conner	Alps	Conner
Average access time	25 ms.	25 ms.	20 ms.	25 ms.	19 ms.	19 ms.	19 ms.	25 ms.
Floppy disk capacity	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB
EXPANSION BUS								
Bus speeds (MHz)	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz
Proprietary expansion slots	1 modem	1 modem	1 modem	1 modem	1 modem	1 modem	1 modem	1 modem
Other expansion slots	None	None	None	None	None	2 full-length	None	1 half-length
External expansion port	■	❑	■	■	❑	■	❑	❑
Expansion unit	■	❑	❑	■	■	■	❑	❑
Self-configuring/Single connection	■ / ■	N/A	N/A	■ / ■	■ / ■	■ / ■	N/A	N/A
VIDEO								
Video modes supported	VGA, MDA, HGA	VGA	VGA, MDA	VGA	VGA, MDA	VGA, MDA	VGA	VGA, MDA
Gray scales at maximum resolution	16	16	16	32	8	32	16	16
Interface	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Chip set manufacturer	Cirrus	Epson	Gemini	Cirrus	Compaq	Compaq	Epson	C&T
Controller location	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard
Simultaneous external display	❑	❑	❑	❑	■	❑	❑	❑
KEYBOARD								
Keys: total, function, cursor	82, 12, 4	85, 12, 8	86, 12, 4	83, 10, 8	82, 12, 4	80, 12, 4	85, 12, 8	83, 12, 4
Keyboard cable length (inches)	18	N/A	N/A	24	24	N/A	N/A	N/A
Keypad connector/Keyboard connector	❑ / ■	❑ / ■	❑ / ■	❑ / ■	■ / ■	■ / ■	❑ / ■	■ / ■
SOFTWARE								
DOS	3.3	4.01 ($60)	3.3, 4.01 ($65)	4.01	3.3, 4.01	3.3 ($120), 4.01 ($150)	4.01	3.3 ($100), 4.01 ($119)
OS/2	None	None	None	None	1.2 ($340)	1.1, 1.22 ($340)	None	1.21 ($299)
Disk caching software	Acache	None	None	None	Compaq	Compaq	None	None
Expanded memory manager	EMM	None	None	None	CEMM	CEMM	None	None
Other	None	None	*Windows* 3.0 ($150)	None	Compaq diagnostics	Compaq diagnostics	DOS HELP!, *Windows* 3.0, *LapLink II*	Dell tutorial

PC—Editors' Choice ■—Yes ❑—No N/A—Not applicable: The product does not have this feature.
C&T—Chips and Technologies Inc.

Dell 320LT	Fora LP386SX Model 70/20	GRiDCase 1550sx	Hyundai Super LT5	NEC ProSpeed SX/20	Network PC Intra LT-386SX	Peregrine Sport SX	Sharp PC-5741	Tangent Model 316L
$3,999	$4,699	$6,345	$3,995	$6,198	$2,499	$2,699	$5,495	$2,768
Direct	Dealers	Dealers	Dealers	Dealers	Dealers, direct	Dealers, direct	Dealers	Direct
20 MHz	20 MHz	20 MHz	16 MHz	20 MHz	16 MHz	16 MHz	20 MHz	16 MHz
AC, battery	AC, battery	AC, battery	AC, battery	AC, battery	AC, battery	AC, battery	AC, battery	AC, battery
3.5 x 12.8 x 14.3	3.3 x 12.8 x 16.1	2.5 x 11.5 x 15	2.5 x 12.5 x 12.3	3.3 x 13.4 x 10.5	2.5 x 12.5 x 12.3	2.5 x 12.5 x 12.3	2.8 x 11.8 x 14	2.5 x 12.5 x 12.3
15	14.5	13	11.6	12.8	11.3	11.3	13.4	11.4
7.9 x 6	8.3 x 6.3	8.3 x 6.3	7 x 5	7.9 x 6	7 x 5.3	7 x 5.3	9 x 6	7 x 5.3
Backlit supertwist LCD	Backlit cold cathode LCD	Backlit thin-film transistor LCD	Backlit supertwist LCD	Backlit supertwist LCD	Backlit supertwist LCD	Backlit supertwist LCD	Backlit supertwist LCD	Backlit supertwist LCD
Dell	Chaplet	Tandy	Sotec	NEC	Sotec	Sotec	Sharp	Sotec
Kyocera	C&T	C&T	Sotec	Oak	Sotec	Sotec	C&T	Sotec
80387SX	None	80387SX	None	None	None	None	80387SX	None
Phoenix 1.10 A00	AMI	Phoenix 1.10	AMI 1.11	Phoenix 1.10	AMI BIOS 1.11	AMI 1.11	Phoenix A386 1.0	AMI 1.11
July 1990	April 1990	September 1990	April 1989	January 1988	September 1989	September 1989	January 1988	September 1989
■ / ■	■ / ■	■ / ■	❑ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
1MB–8MB	1MB–5MB	2MB–8MB	2MB–6MB	1MB–5MB	2MB–6MB	2MB–6MB	2MB–12MB	2MB–6MB
2MB	2MB	2MB	2MB	2MB	2MB	2MB	2MB	2MB
SIMM	DIP	SIP	SIMM	DIP, SIMM	DIP	DIP	SIMM	DIP
70 ns.	80 ns.	80 ns.	80 ns.	80 ns.	100 ns.	100 ns.	80 ns.	100 ns.
1Mb	4x256Kb	1Mb	1Mb	1Mb	1Mb	1Mb	1Mb	1Mb
None	None	None	None	None	None	None	None	None
40MB 3.5-inch	40MB 3.5-inch	60MB 3.5-inch	40MB 3.5-inch	40MB 2.5-inch	40MB 3.5-inch	40MB 3.5-inch	40MB 3.5-inch	40MB 3.5-inch
Conner	Conner	Conner	Conner	PrairieTek	Alps	Alps	Conner	Alps
25 ms.	28 ms.	16 ms.	24 ms.	28 ms.	28 ms.	18 ms.	25 ms.	23 ms.
1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB
8 MHz	6, 8, 10 MHz	8, 10 MHz	8 MHz	8 MHz	8 MHz	6, 8 MHz	8 MHz	6, 8 MHz
1 modem	1 memory	1 modem	1 modem	1 modem	1 modem	1 modem	1 modem	1 modem
1 half-length	2 half-length	None	None	None	None	None	None	None
■	❑	■	❑	■	■	■	❑	■
❑	❑	❑	❑	■	❑	❑	❑	❑
N/A	N/A	N/A	N/A	■ / ■	N/A	N/A	N/A	N/A
VGA	VGA	VGA, MDA	VGA	VGA	VGA, MDA	VGA	VGA, MDA	VGA, MDA
16	16	16	16	16	16	16	16	16
16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
C&T	Cirrus	Cirrus	Gemini	Cirrus	Sotec	Sotec	C&T	Sotec
Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard
❑	❑	❑	❑	❑	❑	❑	■	❑
83, 12, 8	81, 12, 4	77, 12, 4	85, 12, 4	83, 12, 8	85, 12, 4	85, 12, 4	79, 12, 4	85, 12, 4
N/A	N/A	N/A	N/A	34	N/A	N/A	N/A	N/A
■ / ■	❑ / ■	■ / ■	❑ / ■	❑ / ■	❑ / ■	❑ / ■	❑ / ■	❑ / ■
3.3 ($100), 4.01 ($119)	4.01	4.01 ($150)	4.01	4.01	DR-DOS 5.0	4.01	4.01	4.01 ($89)
1.1, 1.21 ($299)	None	None	None	None	None	None	None	None
None	None	None	None	NEC	None	None	Quadtel	None
Dell	None	*386MAX*	None	EMM 4.01	None	None	MM.SYS	None
None	None	*Windows* 3.0	None	None	None	*Windows* 3.0	GW-BASIC 3.23	None

CONTINUES

BATTERY-POWERED 386-BASED PORTABLE PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	386SX-BASED			386-BASED		
	Tangent Model 320L	Toshiba T3100SX	Twinhead SuperLap 386SX/20	Dataworld Data LP/320	Dataworld Data LP/325	Veridata Lappower 386-20
Price of standard configuration	$2,890	$5,699	$3,575	$2,725	$3,580	$4,500
Distribution channel	Direct	Dealers	Direct	Direct	Direct	Dealers
Microprocessor clock speed	20 MHz	16 MHz	20 MHz	20 MHz	25 MHz	20 MHz
Power supply type	AC, battery	AC, battery	AC, battery	AC, battery	AC, battery	AC, battery
Dimensions (HWD, in inches)	3.3 x 12.8 x 16.1	3.2 x 12.2 x 14.2	3.5 x 12.8 x 9.5	3.9 x 12.6 x 14.3	3.9 x 12.6 x 14.3	4.3 x 13.7 x 8.5
Weight (pounds)	14.8	14.9	13.7	19	19	14
Display area (WxH, in inches)	8.3 x 6.3	7.8 x 5.9	6.5 x 8.5	8 x 6	8 x 6	8 x 6
Display technology	Backlit supertwist LCD	Gas plasma	ELD supertwist	Backlit supertwist LCD	Backlit supertwist LCD	Backlit supertwist LCD
Motherboard manufacturer	Chaplet	Toshiba	Twinhead	Dataworld	Dataworld	Veridata
Chip set manufacturer	C&T	Toshiba	C&T	C&T	C&T	Headland
Coprocessor installed	None	None	None	None	None	None
BIOS version	AMI	Award 2.00	Phoenix 1.1020F	Phoenix 1.10 22	Phoenix 1.10 22	Award 3.04
Date	April 1990	November 1990	1989	January 1988	January 1988	August 1990
Video shadowing/System shadowing	■ / ■	■ / ■	■/ ■	■ / ■	■ / ■	■ / ■
MEMORY						
RAM (minimum–maximum)	1MB–5MB	1MB–13MB	2MB–4MB	1MB–8MB	1MB–8MB	2MB–16MB
Installed RAM	2MB	1MB	2MB	2MB	4MB	2MB
RAM packaging	DIP	Proprietary	SIMM	SIMM	SIMM	SIMM
Rated speed	80 ns.	80 ns.	80 ns.	80 ns.	80 ns.	80 ns.
Chip size	4x256Kb	4x256Kb, 1Mb	1Mb	1Mb	1Mb	4x256Kb, 1Mb, 4Mb
Processor RAM cache installed	None	None	None	None	None	None
DISK DRIVES						
Hard disk capacity and size	40MB 3.5-inch	40MB 3.5-inch	40MB 3.5-inch	104MB 3.5-inch	104MB 3.5-inch	40MB 3.5-inch
Manufacturer	Conner	JVC	Conner	Conner	Conner	Conner
Average access time	25 ms.	25 ms.	24 ms.	25 ms.	25 ms.	25 ms.
Floppy disk capacity	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB	1.44MB
EXPANSION BUS						
Bus speeds	6, 8, 10 MHz	8, 10 MHz	8 MHz	8 MHz	8 MHz	8, 12 MHz
Proprietary expansion slots	None	1 modem, 1 CRT	1 modem	None	None	None
Other expansion slots	2 half-length	None	None	1 half-length	1 half-length	None
External expansion port	❑	■	■	■	■	■
Expansion unit	❑	■	■	❑	❑	❑
Self-configuring/Single connection	N/A	❑ / ■	■ / ■	N/A	N/A	N/A
VIDEO						
Video modes supported	VGA, MDA, HGA	VGA	VGA	VGA	VGA	VGA, MDA
Gray scales at maximum resolution	16	16	32	16	16	16
Interface	16-bit	16-bit	16-bit	16-bit	16-bit	8-bit
Chip set manufacturer	Cirrus	Paradise	Cirrus	Cirrus	Cirrus	GCD
Controller location	Motherboard	Motherbaord	Motherboard	Daughterboard	Daughterboard	Motherboard
Simultaneous external display	❑	■	■	❑	❑	❑
KEYBOARD						
Keys: total, function, cursor	81, 12, 4	86, 12, 8	83, 12, 4	81, 10, 4	81, 10, 4	86, 12, 4
Keyboard cable length (inches)	N/A	N/A	18	N/A	N/A	36
Keypad connector/Keyboard connector	❑ / ■	■ / ■	❑ / ■	■ / ■	■ / ■	■ / ■
SOFTWARE						
DOS	3.3, 4.01	4.01	4.01	4.01 ($85)	4.01 ($85)	DR-DOS 3.41
OS/2	None	None	None	None	None	None
Disk caching software	None	None	None	None	None	None
Expanded memory manager	None	None	EMM	Dataworld	Dataworld	None
Other	None	None	None	None	None	None

—Editors' Choice ■—Yes ❑—No N/A—Not applicable: The product does not have this feature.
C&T—Chips and Technologies Inc.

CONTINUES

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CIRCLE 146 ON READER SERVICE CARD

BATTERY-POWERED 386-BASED PORTABLE PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Acer AnyWare 1100LX	Bitwise SportSX	Bus LT-386sx	Commax Excell LT-386SX	Compaq SLT 386s/20 Model 120	Compaq LTE 386s/20 Model 30	CompuAdd 316SL	Dell 316LT
386SX-BASED								
COMMUNICATIONS								
Internal modem	2,400 bps ($199)	2,400 bps ($275)	2,400 bps ($250)	2,400 bps ($199)	2,400 bps ($599)	2,400 bps ($599)	2,400 bps ($249)	2,400 bps ($399)
V.42bis/MNP 5	❑/■	❑/❑	■/■	❑/❑	■/■	■/■	❑/❑	❑/■
Modem options	None	Send-fax	Fax	None	None	None	Send-fax	Fax
Internal network card	None	None	None	None	None	None	None	Ethernet ($199)
PHYSICAL FEATURES								
Power supply (watts)	55	37	35	41	20	35	37	53
Dual voltage	❑	❑	❑	❑	■	■	❑	■
Power-on/reset switch	Front/none	Side/side	Side/side	Side/top	None/none	Top/none	Side/side	Side/side
BATTERY								
Claimed battery life (hours)	2.5	2.5	3	2.5	3	3	2.5	2.3
Charge time (hours) with unit on, off	5, 1.5	8, 3	8, 4	8, 7	3, 1.5	8, 3	8, 3	24, 1.5
Battery voltage, Amp/hours	12V, 2.5Ah	12V, 2.4Ah	17V, 2.2Ah	12V, 1.7Ah	12V, 2.4Ah	19.2V, 1.7Ah	12V, 2.4Ah	10.8V, 2.8Ah
Shutdown:								
Display/disk	■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/■
System/peripherals	■/❑	■/❑	■/❑	■/❑	■/❑	■/■	■/❑	❑/■
Transformer weight (pounds)	1.7	1.8	1.8	1.6	1.7	1	1.8	2.7
Transformer size (inches)	3 x 6.5 x 2	5.2 x 8 x 3.2	5.2 x 8 x 3.2	3 x 6.5 x 2	3.4 x 8.6 x 2.4	2.9 x 5.8 x 1.3	5.2 x 8 x 3.2	3 x 9.1 x 3.8
MISCELLANEOUS								
Car battery adapter available	❑	■	❑	■	■	■	❑	■
Coprocessor supported	80387SX	80386SX	80387SX	80386SX	80387SX	80387SX	80387SX	80387SX
Setup in ROM/Password in ROM	■/■	■/❑	■/❑	■/❑	■/❑	❑/■	■/❑	■/❑
Warranty	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year
Service	Dealer	Vendor	Vendor	Dealer	Dealer, vendor	Dealer	Dealer, vendor	On-site
FCC certification class	B	B	B	B	B	B	B	B
FCC identification number	IPL1100LX	EF7A918SUT	EF7A918SUT	FKGSUPERLAP-386SX	CNT75784	CNT75MAF0	EF7A918SUT	E2K316LT

PC—Editors' Choice ■—Yes ❑—No

Fora LP386SX Model 70/20, $4,699.

an adapter cable with a DIN connector on one end and a DB-9 on the other.

The system's memory uses 1MB, 80-nanosecond DIP-type RAM on the system board; optional memory cards with either 1MB or 4MB of DIP-type RAM on the card are available. The cards plug into an extension to the system board. As tested, the Model 70/20 included the 1MB memory card, yielding 2MB total. The hard disk is a 40MB Conner IDE drive, complete with its own controller.

The keyboard and screen on this system are arguably its best points. The keyboard has much the same feel as the popular Toshiba portables. The backlit LCD is not as bright or readable as the Dell 320LT's but is still extremely readable. Also worth mention are the two half-length 16-bit slots under the back panel of the system.

Fora claims about 2 hours rundown time for the battery, but PC Magazine Labs' Battery Rundown test showed a time of just over an hour. Obviously, the motto for the AC adapter is "Don't leave home without it." The total weight of the system and adapter is just under 17 pounds.

The Model 70/20 is a decidedly average system at a higher-than-average price. The screen and keyboard are worth praise, but the large size, heavy weight, low battery life, and high price significantly outweigh these good points. If you can find the system at a low price comparable to the Tangent's, you might consider it. But there's

FACT FILE

Fora LP386SX Model 70/20
Fora Inc., 3081 N. First St., San Jose, CA 95134; 800-367-3672, 408-944-0393.
List Price: With 1MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 4.01, $4,499.
Options: 1MB RAM upgrade, $200; 2,400-bps modem, $240; extra battery, $100; numeric keypad, $95.
In Short: Even with its readable screen and comfortable keyboard, the 14.5-pound Fora LP386SX Model 70/20 is too heavy and too bulky and its battery life is too short to justify its list price. Look for substantial discounts from your dealer, or get the same system by mail order from Tangent.

CIRCLE 605 ON READER SERVICE CARD

	Dell 320LT	Fora LP386SX Model 70/20	GRiDCase 1550sx	Hyundai Super LT5	NEC ProSpeed SX/20	Network PC Intra LT-386SX	Peregrine Sport SX	Sharp PC-5741	Tangent Model 316L
	2,400 bps ($179)	2,400 bps ($240)	2,400 bps ($595)	2,400 bps ($395)	2,400 bps ($399)	2,400 bps ($215)	2,400 bps ($199)	2,400 bps ($499)	2,400 bps ($179)
	❑/■	❑/■	❑/■	❑/❑	❑/■	❑/❑	❑/❑	❑/■	❑/❑
	Fax	Fax	Fax	None	Fax	Fax	None	Fax	Fax
	None	None	None	None	None	None	None	None	None
	48	54	60	48	42	48	26	35	26
	■	■	■	■	■	❑	■	■	■
	Side/side	Back/none	Back/none	Side/side	Side/side	Side/side	Side/side	None/side	Side/side
	2.3	1.5	3	1-3	3	3	3	2	3
	24, 1.5	8, 4	8, 2.5	8, 3	5, 2	8, 4	8, 3.5	10, 5	8, 3.5
	10.8V, 2.8Ah	12V, 2.5Ah	16.2V, 3.7Ah	12V, 2.4Ah	12V, 2.8Ah	12V, 2.4Ah	12V, 2.4Ah	17V, 2.31Ah	12V, 2.4Ah
	■/■	■/■	■/■	■/❑	■/■	■/■	■/■	■/■	■/■
	❑/❑	❑/❑	■/■	■/❑	■/❑	❑/❑	❑/❑	■/■	❑/❑
	2.6	2.1	1.1	1.6	1.1	1.8	1.9	1.7	1.9
	4 x 9.5 x 3.3	3.8 x 6.3 x 3	2.9 x 5.8 x 1.4	2.3 x 8 x 3.2	2.1 x 7.9 x 3.1	3.3 x 8.5 x 2.3	2.3 x 7.9 x 3.1	2.3 x 6.9 x 3.4	2.3 x 7.9 x 3.1
	■	❑	■	❑	■	■	❑	❑	❑
	80387SX	80387SX	80387SX	80387SX	80387SX	80387SX	80387SX	80387SX	80387SX
	■/❑	■/❑	■/■	■/❑	■/■	■/❑	■/❑	■/❑	■/❑
	1 year	1 year	1 year	18 months	1 year	1 year	1 year	1 year	1 year
	On-site	Dealer	Dealer	Dealer, on-site	Dealer	Vendor	Vendor	Dealer	Vendor
	B	B	B	B	B	B	B	B	B
	E2K320LT	GXLLA-50	F2J1550	EF7A918SUT	A3DPC43	EF7A918SUT	EF7A918SUT	APYNAR0005	EF7A918SUT

CONTINUES

certainly no reason to pay more than the $2,890 that Tangent charges for the same computer.

GRID SYSTEMS CORP.

GRiDCase 1550sx

by Greg Pastrick

GRiD Systems Corp.'s first laptop, the GRiD Compass Computer, saw duty in the NASA space shuttle program. Over the years, GRiD portables have seen more down-to-earth use in the private and government sector. Then as now, the consistent ink-black, smart styling of GRiD's product line lent an air of advanced technology and purposeful mission to the company's portable computers.

This is no less true with the standard configuration of GRiD's $6,345 GRiDCase 1550sx, a 20-MHz 80386SX-based laptop with 2MB of RAM, a 60MB hard disk, 1.44MB 3.5-inch floppy disk drive, 32-gray-scale VGA display system, and software, including GRiD's licensed version of DOS 4.01, *Microsoft Windows* 3.0, and *386MAX* extended-memory management software. Typical of GRiD's beyond-the-ordinary approach to portable computing, the GRiDCase comes equipped with a unique built-in mouse substitute called an IsoPoint control bar.

The IsoPoint bar, a pencil-like rolling and sliding tube flanked on either side by two smooth rounded buttons, is built into the case directly below the keyboard's spacebar. You'll probably master the bar's point, click, and drag action fairly easily, using your index finger and thumb. Free-form drawing with the IsoPoint, however, produces limited results—similar to creating sweeping arcs and circles using an Etch-A-Sketch. The Control Panel utility allows you to adjust pointer travel, speed, and control bar sensitivity. Turning the IsoPoint off is as simple as typing Mouse Off, provided Mouse.sys is loaded.

GRiDCase 1550sx, $6,345.

Even more interesting hardware is found inside the 2.5- by 11.5- by 15-inch coal-colored magnesium alloy case.

BATTERY-POWERED 386-BASED PORTABLE PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	386SX-BASED			386-BASED		
	Tangent Model 320L	Toshiba T3100SX	Twinhead SuperLap 386SX/20	Dataworld Data LP 320	Dataworld Data LP/325	Veridata Lappower 386-20
COMMUNICATIONS						
Internal modem	2,400 bps ($176)	2,400 bps ($349)	2,400 bps ($249)	2,400 bps ($110)	2,400 bps ($110)	2,400 bps ($249)
V.42bis/MNP 5	❑/❑	■/■	■/■	❑/❑	❑/❑	■/■
Modem options	Fax	Fax	None	Fax	Fax	None
Internal network card	None	Ethernet ($699)	None	Ethernet ($169)	Ethernet ($169)	None
PHYSICAL FEATURES						
Power supply (watts)	54	60	46	40	40	63
Dual voltage	■	■	❑	■	■	■
Power-on/reset switch	Back/none	Side/side	Side/top	Back/none	Back/none	Side/none
BATTERY						
Claimed battery life (hours)	2	3	3	1	1	2
Charge time (hours) with unit on, off	8, 4	16, 3	2, 2	8, 6	8, 6	3, 2
Battery voltage, Amp/hours	12V, 2.5Ah	9.6V, 2.4Ah	12V, 2.4Ah	10.8V, 4.5Ah	10.8V, 4.5Ah	14.4V, 24Ah
Shutdown:						
Display/disk	■/■	■/■	■/■	■/■	■/■	■/■
System/peripherals	❑/❑	■/■	■/■	❑/❑	❑/❑	■/■
Transformer weight (pounds)	2.1	1.6	1.3	1.9	1.9	2
Transformer size (inches)	3.8 x 6.3 x 3.0	2.8 x 5.4 x 1	2 x 7.3 x 3.3	3.3 x 8.5 x 2.3	3.3 x 8.5 x 2.3	2.1 x 7.5 x 3.2
MISCELLANEOUS						
Car battery adapter available	❑	❑	❑	■	■	❑
Coprocessor supported	80387SX	80387SX	80387SX	80287, 80387	80287, 80387	80387
Setup in ROM/Password in ROM	■/❑	❑/❑	■/❑	❑/■	❑/■	■/❑
Warranty	1 year	1 year	1 year	1 year	1 year	1 year
Service	Vendor	Dealer, vendor	Dealer	On-site	On-site	Dealer
FCC certification class	B	B	B	B	B	B
FCC identification number	GXLLA-60	CJ6UN625	FKGSUPERLAP-386SX	FMA8100	GS8TDATA-LN55	HLOLAPPOWER386

PC—Editors' Choice ■—Yes ❑—No

ENDS

GRiD's Tandy-built 16-bit motherboard holds the 80386SX processor, a socket for a $795 20-MHz 80387SX math coprocessor, the Chips and Technologies chip set, Phoenix ROM BIOS, and 2MB of page-mode, 70-nanosecond SIP system memory, expandable to 8MB. Memory upgrades cost $1,190 to expand to 4MB and $3,295 to go to 8MB. Processor speeds are keyboard-selectable for 10- or 20-MHz operation.

The GRiDCase's 8.3- by 6.3-inch backlit LCD presents clean, well-formed dark characters on a bright background at 640-by-480 resolution. This VGA display, which supports EGA, CGA, and MDA modes, is a major improvement over the Halloween-color black-on-orange CGA screens of the past. The VGA system achieved average scores on PC Magazine Labs' video tests, however.

Key travel in the 77-key keyboard is a bit short and tight, but the layout is sensible, and the embedded keys are clearly labeled. Its 12 function keys are laid out across the top of the board. There is a port for an external AT-style keyboard or numeric keypad.

FACT FILE

GRiDCase 1550sx
GRiD Systems Corp., 47211 Lakeview Blvd., P.O. Box 5003, Fremont, CA 94537-5003; 800-222-4743, 415-656-4700.
List Price: With 2MB RAM, 60MB hard disk, 1.44MB 3.5-inch floppy disk drive, VGA display, *Microsoft Windows* 3.0, *386MAX*, DOS 4.01, $6,345.
Options: 2MB RAM upgrade, $1,190; 6MB RAM upgrade, $3,295; upgrade to 120MB hard disk, $700; math coprocessor, $795; 2,400-bps modem, $595; extra battery, $150; numeric keypad, $195; external 1.2MB floppy disk drive, $595; carrying case, $60.
In Short: GRiD has corrected deficiencies of early models in the 1500 laptop series and put together a full-featured, fine-functioning 20-MHz 386SX laptop with many options and multiple power configurations. The IsoPoint pointing device substitutes for a mouse, with mixed results.

CIRCLE **606** ON READER SERVICE CARD

The GRiDCase has no shortage of ports. In addition to the keyboard plug, the laptop has one 25-pin parallel port, two 9-pin serial ports, one 15-pin monitor port, and a 25-pin external drive port.

The GRiDCase comes equipped with several power configuration options, including an automobile battery adapter cable. PC Magazine Labs' Battery Rundown test on the nickel cadmium battery pack showed it to have 1 hour 50 minutes of independent power. With the external power supply and battery pulled from the bay, an internal trickle-charged bridge battery takes over and offers about 20 minutes of power to secure the system or go to alternative power.

The performance deficiencies in early models of the GRiDCase 1500 series have been well taken care of in this full-powered 386SX laptop. Given its performance on the PC Labs tests, the GRiDCase runs as well as any of the SXs reviewed here. The GRiDcase's 60MB Conner hard disk is rated at 16 milliseconds. The GRiDCase

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SILENCER 220 — $139

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TURBO-COOL 450 — $349

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CIRCLE 482 ON READER SERVICE CARD

can be fitted with a 120MB drive for an additional $700.

Options is a key word with the GRiDCase 1550sx. While you can get a basic system for $4,505, that machine comes without a hard disk or VGA LCD. Tack on extra memory, a coprocessor, the 2,400-bit-per-second, MNP 5, V.22bis modem ($595), and the total system price heads into the $7,000-to-$8,000 range. Consider external options, and the overall price can reach $10,000.

This adds up to some heady pricing, but in return you get a hard-working, tough, and handsome laptop.

FACT FILE

Hyundai Super LT5
Hyundai Electronics America, 166 Baypointe Pkwy., San Jose, CA 95134; 800-727-6972, 408-473-9200.
List Price: With 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 4.01, $3,995.
Options: 2,400-bps modem, $395; extra battery, $145; carrying case, $95.
In Short: One of seven distributors of the Sotec-based portable, Hyundai sells this system equipped with a Conner hard disk. The price is quite high compared with other versions of this system, but you can expect a 30 to 40 percent discount from your dealer. Options, too, are provided by the dealer, though Hyundai itself backs the system for 18 months.

CIRCLE 607 ON READER SERVICE CARD

HYUNDAI ELECTRONICS AMERICA

Hyundai Super LT5

by Bill O'Brien

The similarities between Hyundai's line of cars and its 16-MHz 80386SX-based Super LT5 laptop won't be lost on you. Both are compact, offer midrange performance, and provide enough room for comfortable use on long road trips.

For a list price of $3,995, the 11.6-pound Super LT5 gives you 2MB of 80-nanosecond RAM, a 40MB Conner IDE hard disk, a 1.44MB floppy disk drive, a VGA display, DOS 4.01, and, tucked under a hinged cover, parallel, serial, and game ports as well as an external VGA port. An AC adapter adds 1.6 pounds to the package.

Hyundai Super LT5, $3,995

Standard fare is a proprietary motherboard with an AMI BIOS. The Sotec motherboard has room for an additional 4MB of RAM as well as an 80387SX math coprocessor. Its single proprietary socket is designed to hold an optional 2,400-bps modem, which adds $395 to the cost of the system.

Upgrading the hardware won't be a problem if you're nimble with a screwdriver, though you'll have to get many of the components from sources other than Hyundai. Three screws at the bottom of the 2.5- by 12.5- by 12-inch case release the keyboard and expose both the expansion memory and coprocessor sockets. To enable memory or coprocessor additions, you must set a DIP switch at the rear of the machine; the various settings are outlined in the machine's manual. The optional screw-in modem slides in through a rear-access hatch.

A highly noticeable cavity at the right rear of the Hyundai Super LT5 is for the battery pack, which is rated to provide between 1 and 3 hours of computing time.

In our Battery Rundown test, which employs none of the system's shutdown features, the battery lasted for 2 hours 1 minute. The battery slips into place on molded rails and has a positive-locking system that holds it firmly in place. In fact, once you've attached the battery, you'll be hard-pressed to find any obvious method of disengaging it, since the release button is well integrated with the overall styling of the case. It takes 8 hours to recharge the battery with the system on or 3 hours with it off.

Along the right side of the machine are the power switch and 1.44MB floppy disk drive. The left side holds the AC adapter jack, the reset button (which is recessed

BENCHMARK TESTS: BATTERY-POWERED 386-BASED PORTABLE PCs

While the Compaqs performed well across all our tests, their prowess on the processor tests can be traced to their 4K four-way set associative cache. They are the only systems to use processor RAM cache in this group of portables.

The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

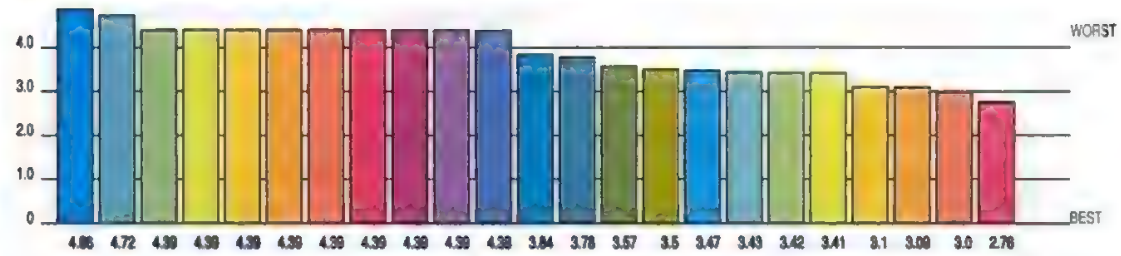
The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

For this section we tested 24 386SX and 386 battery-powered portables, using PC Magazine Labs' Hardware Performance Tests, Release 5.6. We ran the tests with video and system shadowing enabled wherever possible, and we left the buffers at their default values. We used no software disk caches when performing disk benchmark tests, and no RAM-resident programs were loaded for any tests. The margin of error for the processor, memory, and video benchmark tests is 0.05 seconds, so take this into account when making purchasing decisions based primarily on speed.

PROCESSOR AND MEMORY BENCHMARK TESTS

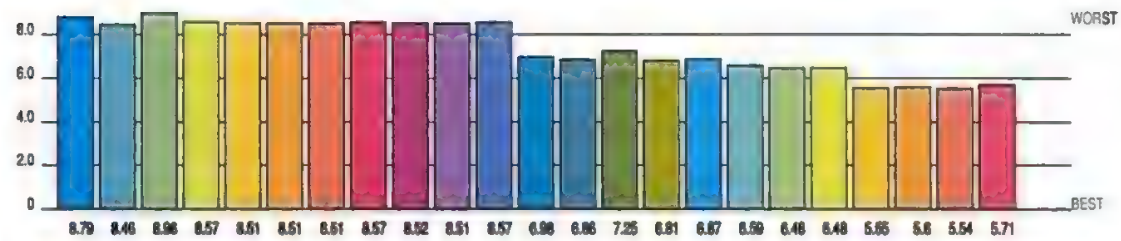
80386 Instruction Mix

Elapsed Time (seconds)



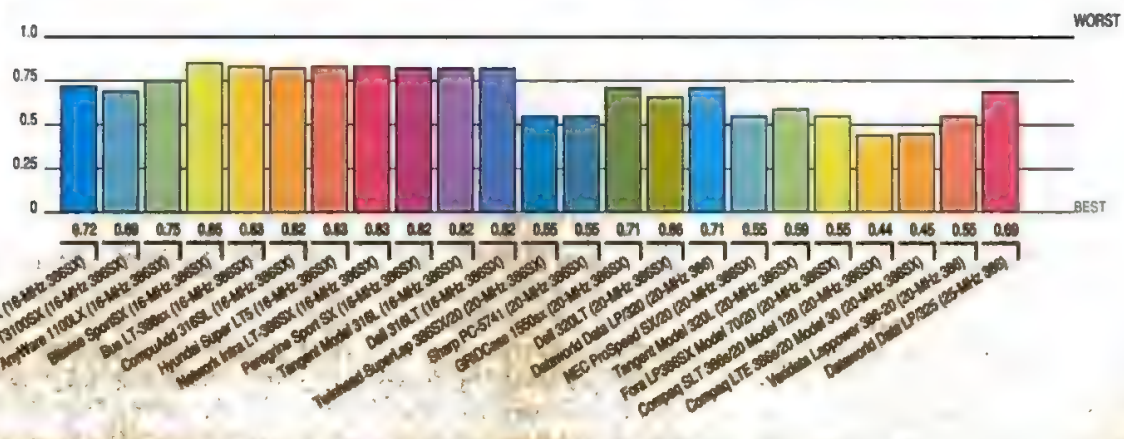
Floating-Point Calculation Without Coprocessor

Elapsed Time (seconds)



Conventional Memory

Elapsed Time (seconds)



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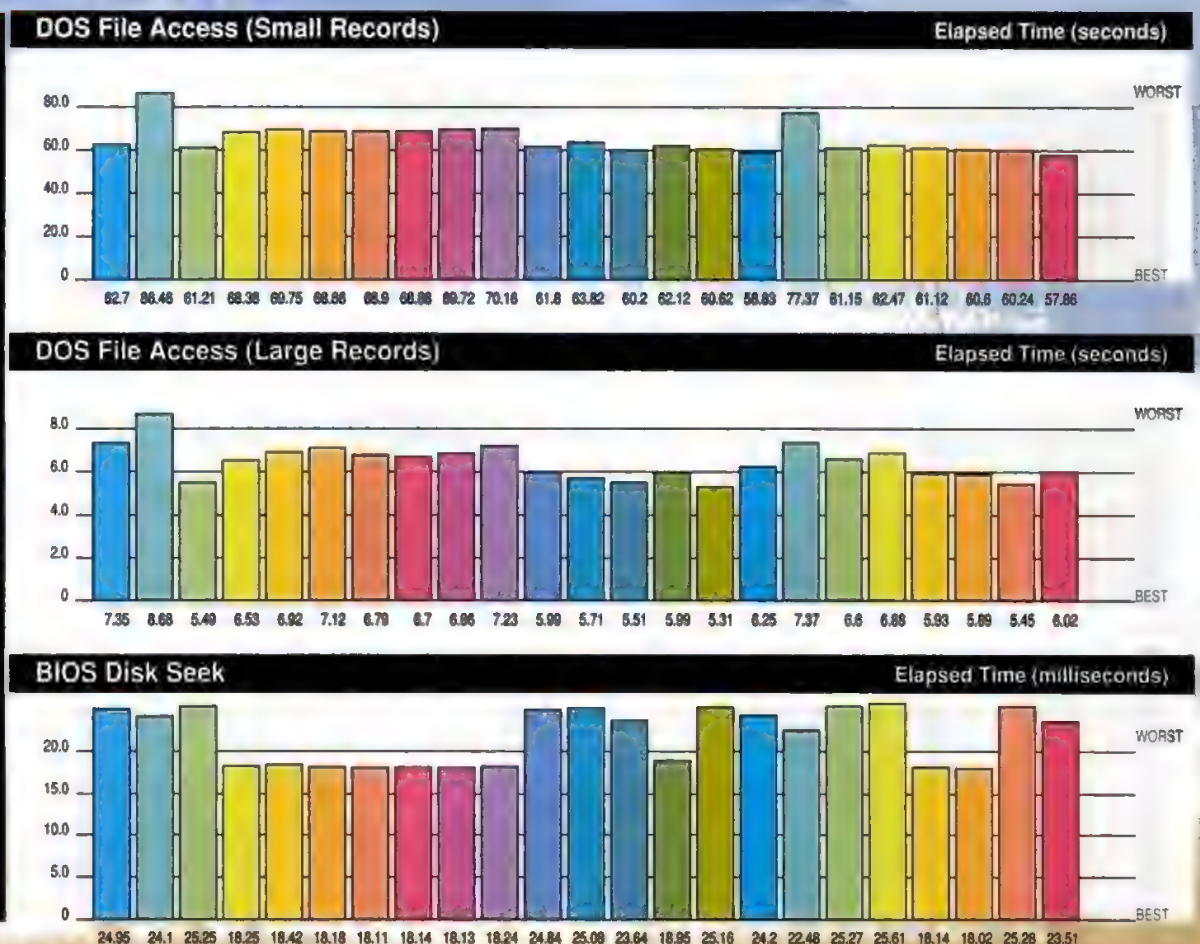
BENCHMARK TESTS: BATTERY-POWERED 386-BASED PORTABLE PCs

DISK BENCHMARK TESTS



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into the case), and the external keyboard connector, which sits under a removable hatch cover. If you're wise, you'll attach some Velcro to this small hatch cover and stick it to an inconspicuous spot on the case when you use an external keyboard; otherwise, it's bound to get lost. The power switch is rear-mounted, as is the modem jack when the optional modem card is installed.

The 85-key Hyundai keyboard is well designed and traditionally laid out, despite the fact that you need to refer to confusing legends to learn the multiple identities of keys used as a numeric keypad. Twelve function keys line up across the top of the keyboard, and there is a separate arrow key cluster.

The excellent 5- by 7-inch VGA cold cathode LCD panel is driven by a Hyundai chip set and supports 16 shades of gray at a maximum pixel resolution of 640 by 480. Brightness and contrast controls are situated on the display panel, obviating an accidental change from a careless swipe of the hand.

Visually, Hyundai's documentation is pathetic, with a multiplicity of type styles and fonts. Fortunately, though, the content is well thought out and provides all of the information that you'll need in order to use the Super LT5. Should the portable come to harm, Hyundai guards it with an exceptional 18-month warranty covering both parts and labor.

As for performance, the Super LT5 de-

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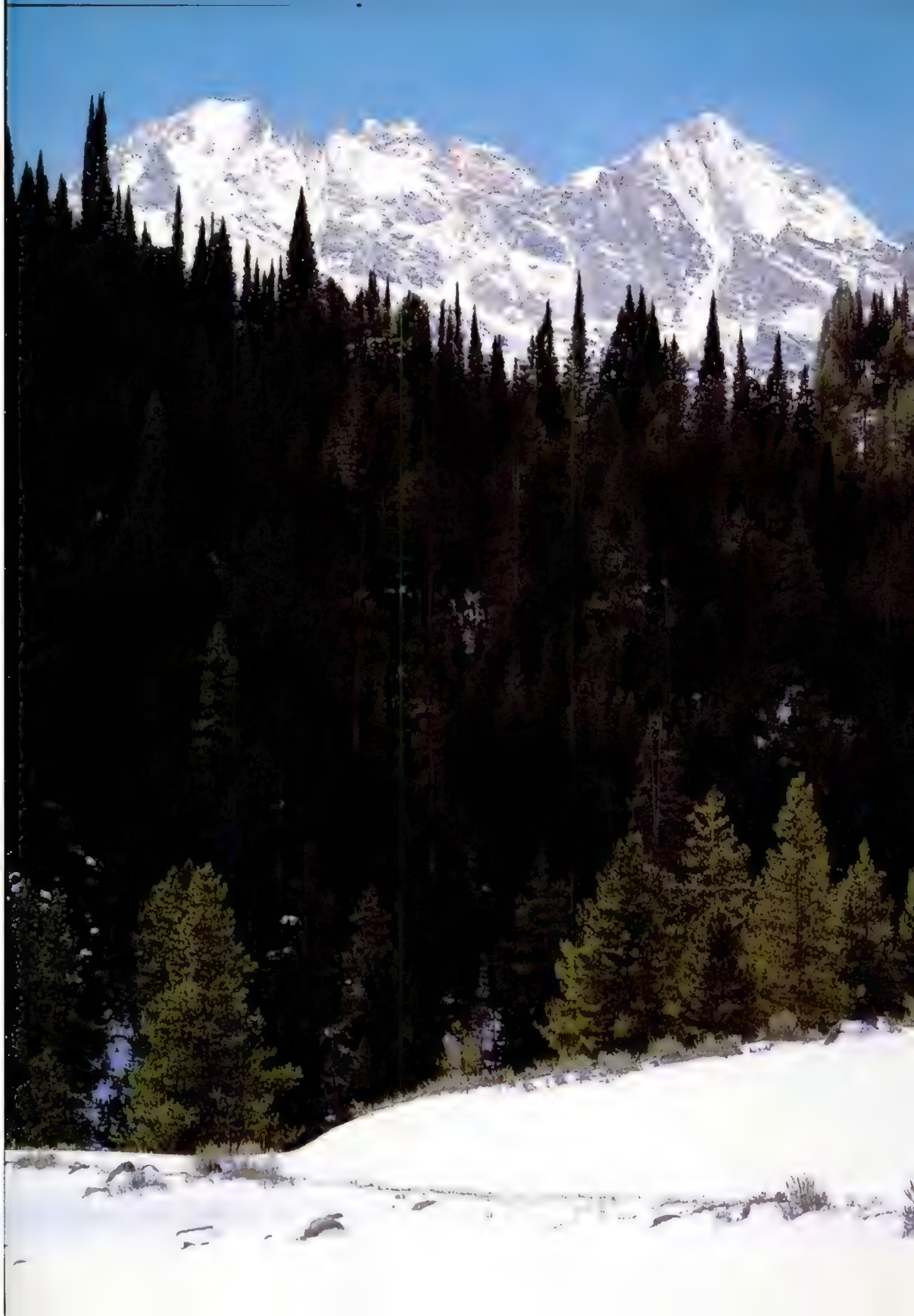
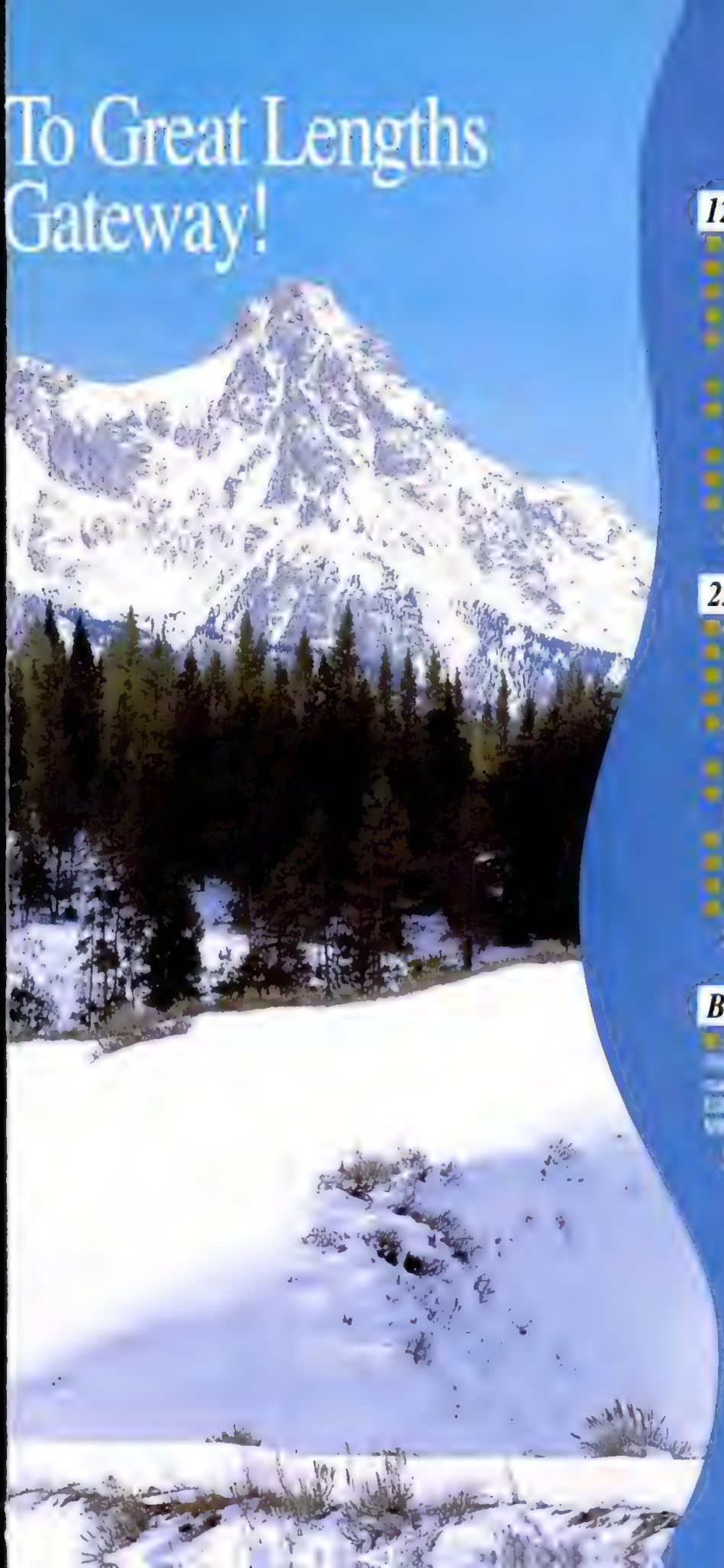


'Round Icy Curves...

To Great Lengths Gateway!



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- 16 Bit VGA with 1 MB
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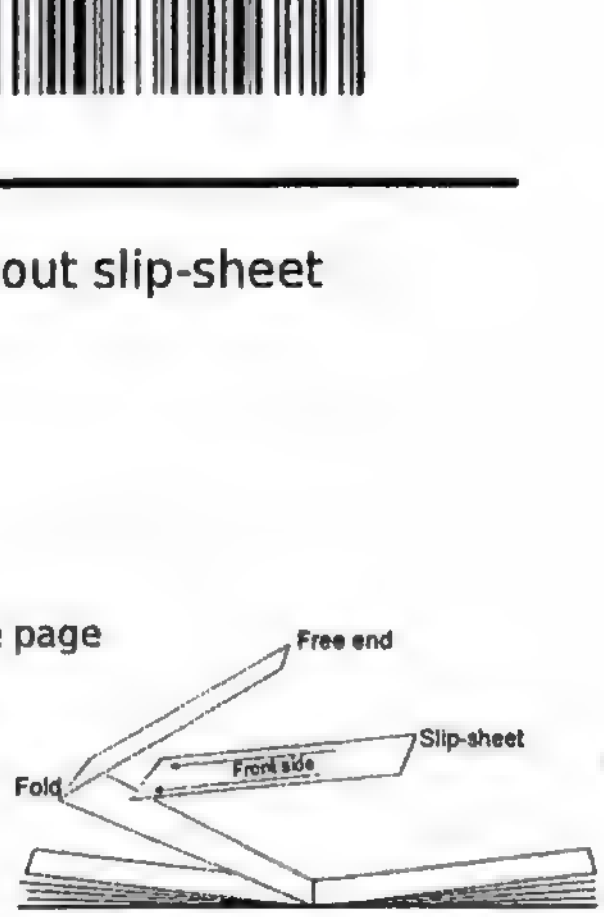
Folded edge of the page

GbsSlipSheet-001

Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

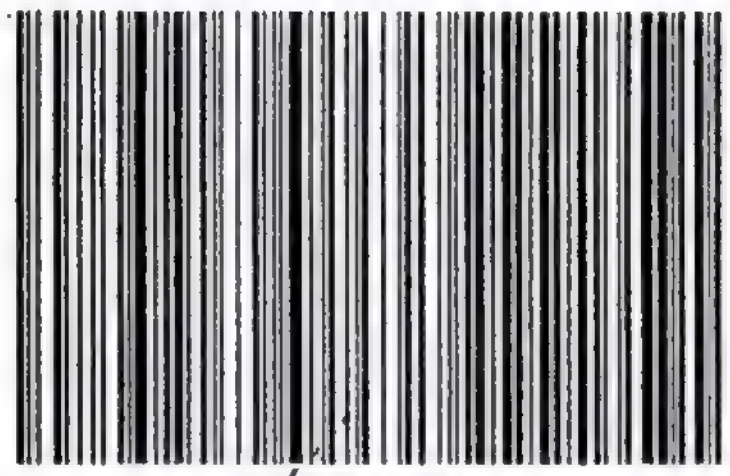


Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet

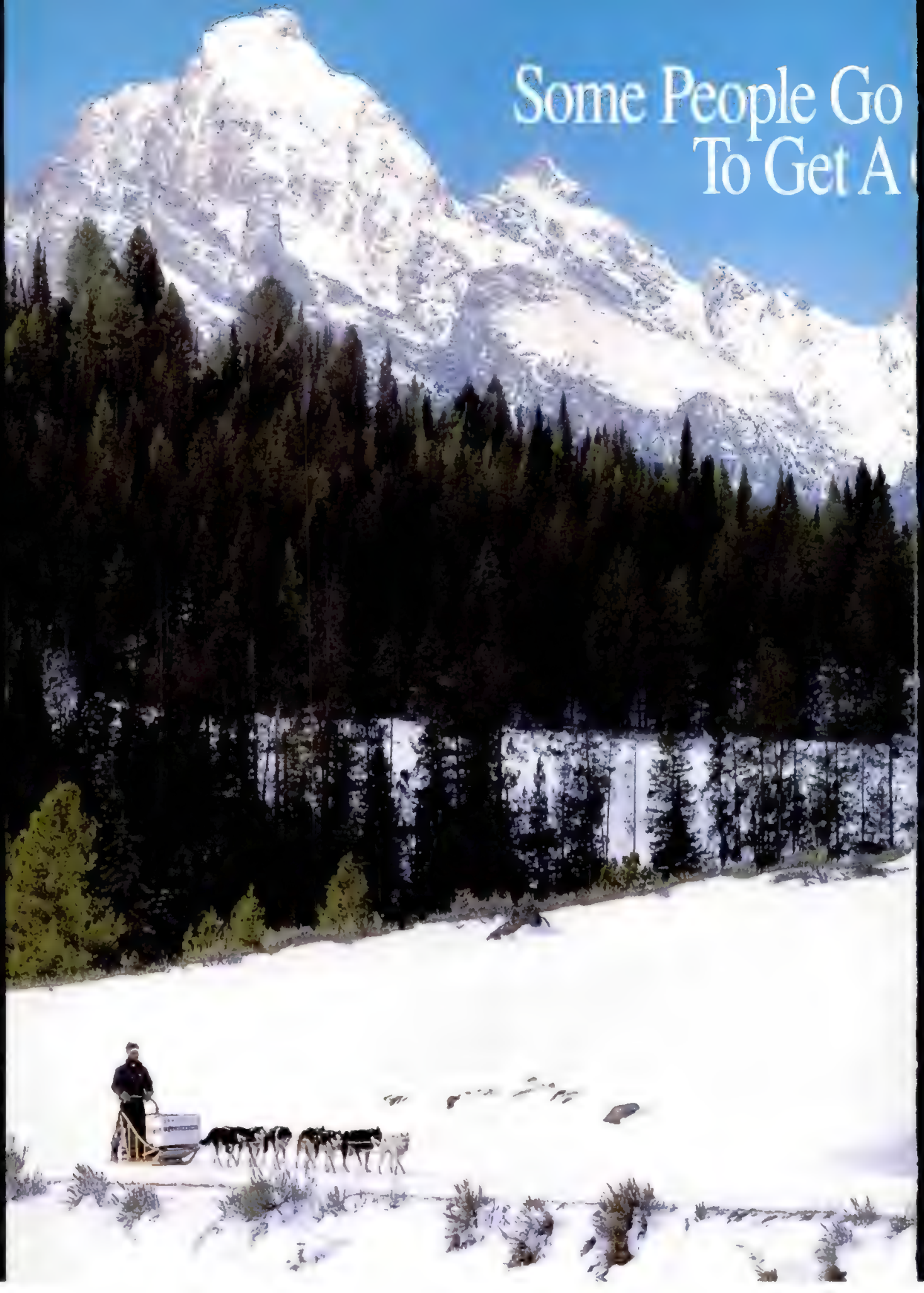
Inverted Back

1. Follow instructions on the other side



Back

1. Follow instructions on the other side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Every Gateway 2000 system comes with a one-year warranty on parts and service. If a part needs to be replaced, we'll quickly send a replacement part via overnight shipping free of charge. Beyond the warranty, we provide free telephone technical support for the life of your machine.

Free On-Site Service

If unusual difficulties occur, we can provide free on-site service to most locations in the country.

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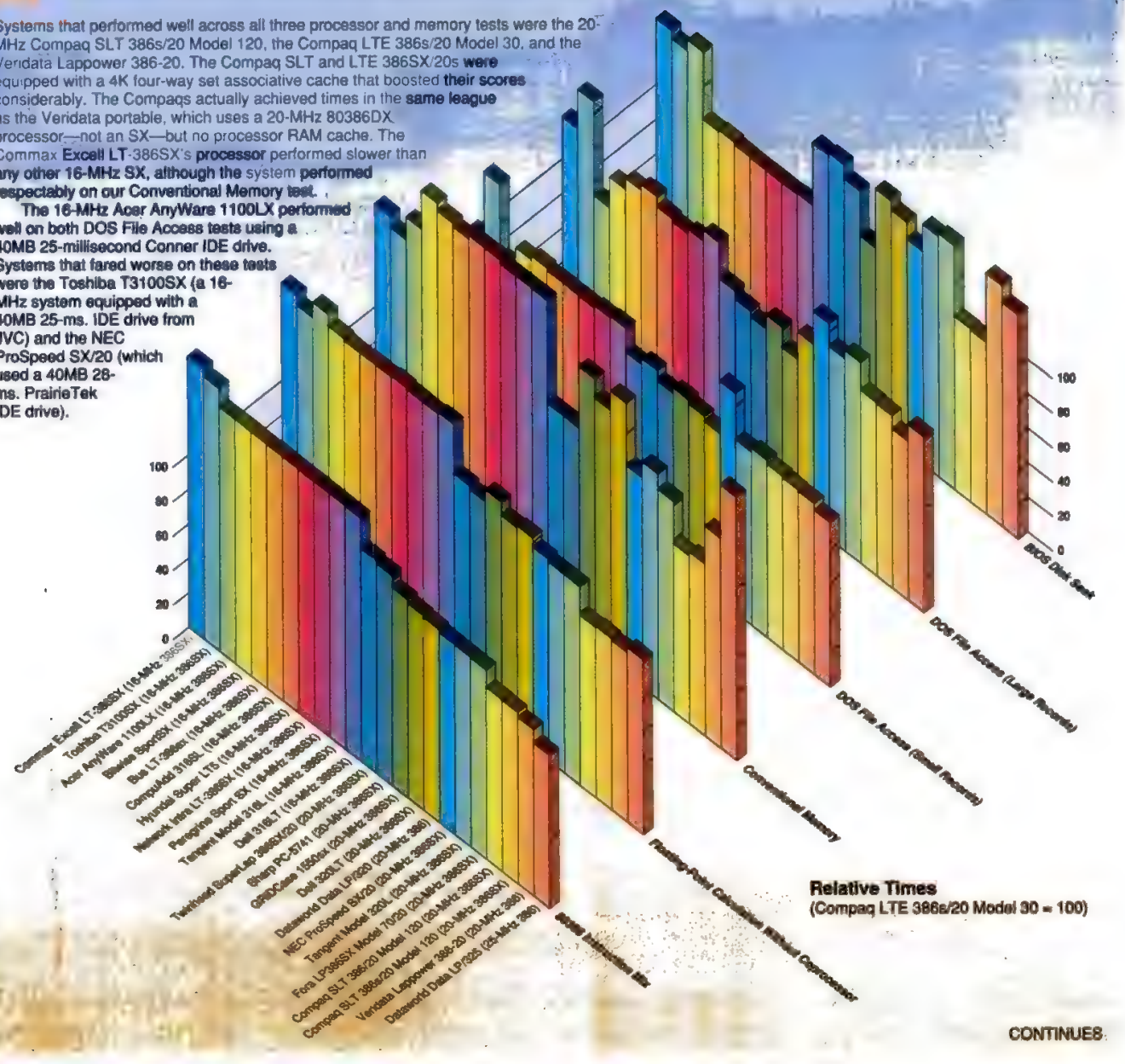
PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

Systems that performed well across all three processor and memory tests were the 20-MHz Compaq SLT 386s/20 Model 120, the Compaq LTE 386s/20 Model 30, and the Veridata Lappower 386-20. The Compaq SLT and LTE 386SX/20s were equipped with a 4K four-way set associative cache that boosted their scores considerably. The Compaqs actually achieved times in the same league as the Veridata portable, which uses a 20-MHz 80386DX processor—not an SX—but no processor RAM cache. The Commax Excell LT-386SX's processor performed slower than any other 16-MHz SX, although the system performed respectably on our Conventional Memory test.

The 16-MHz Acer AnyWare 1100LX performed well on both DOS File Access tests using a 40MB 25-millisecond Conner IDE drive. Systems that fared worse on these tests were the Toshiba T3100SX (a 16-MHz system equipped with a 40MB 25-ms. IDE drive from JVC) and the NEC ProSpeed SX/20 (which used a 40MB 28-ms. PrairieTek IDE drive).



CONTINUES

livered below-average times on PC Magazine Labs' benchmark tests, with two exceptions: Its Conner hard disk came in first in our BIOS Disk Seek test; it also scored well on the processor test.

The Hyundai Super LT5's list price is on the high side, though you should get a 30 to 40 percent discount from your dealer. But portables are subjected to the most abuse of any type of computer, and Hyundai's longer-than-average warranty may make the price more palatable.

NEC TECHNOLOGIES INC.

NEC ProSpeed SX/20

by John R. Quain

If you hate traveling because you have to leave all your stuff at home, consider NEC's ProSpeed SX/20. This 12.8-pound 20-MHz 80386SX machine with 2MB of RAM, a 40MB hard disk, a 1.44MB floppy disk drive, a VGA LCD, a detachable keyboard, and DOS 4.01 is powerful enough to provide all the computing comforts of home.

NEC wasn't able to deliver the $6,398 SX/20 in time for last year's laptop roundup, but it did deliver on its promises. The 3.3- by 13.4- by 10.5-inch SX/20 improves on the heftier and slower NEC ProSpeed 386/SX (a 16-MHz model) by trimming about 4 pounds, increasing screen performance, and incorporating enough design changes so that the two machines

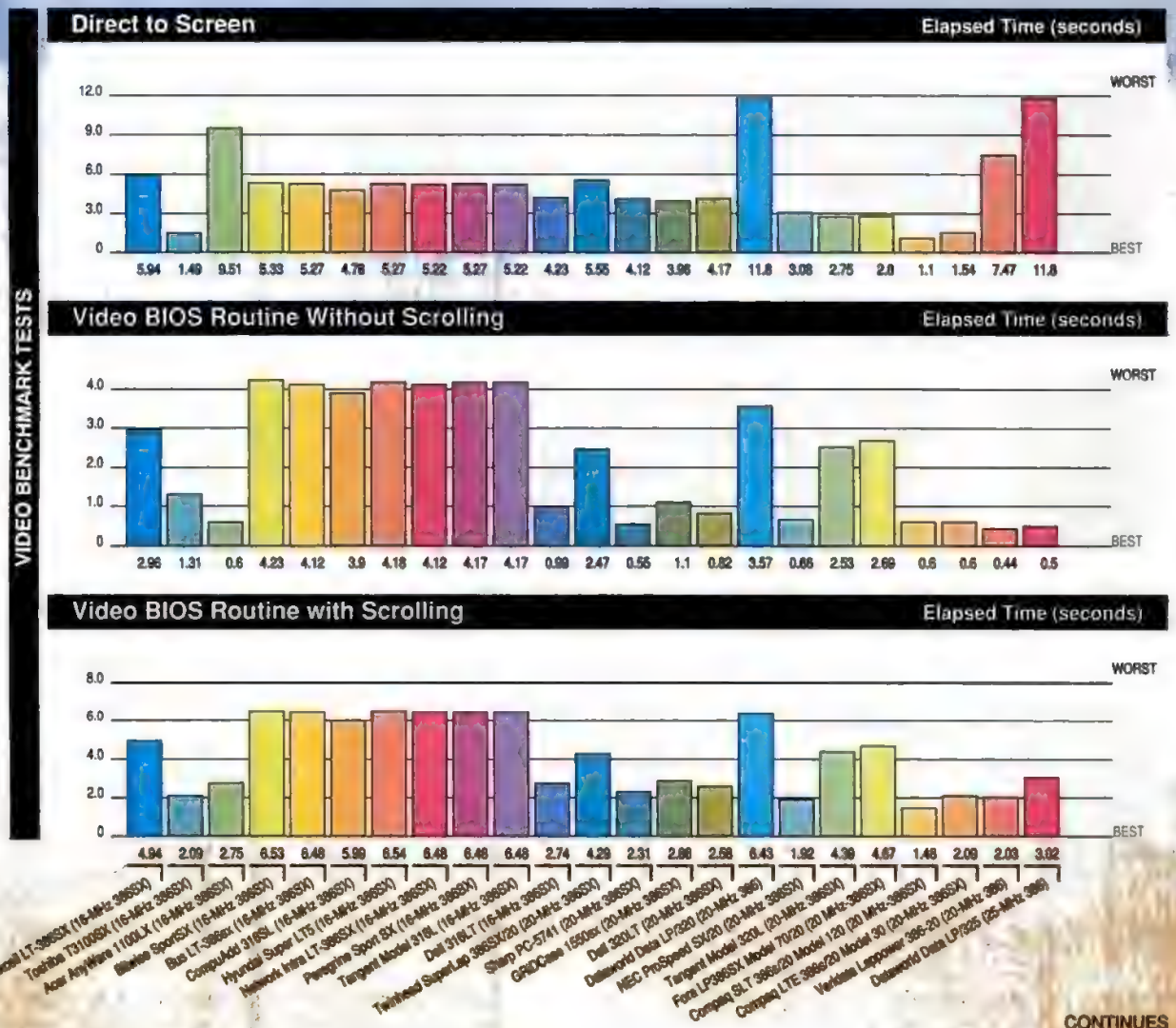
BENCHMARK TESTS: BATTERY-POWERED 386-BASED PORTABLE PCs

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.

VIDEO BENCHMARK TESTS



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have about as much in common as Ted Kennedy and George Bush. Still, this system is one of the heavier ones we've looked at, weighing nearly 13 pounds.

Employing a chip set from Oak Technologies, the NEC SX/20 uses a Phoenix BIOS and can handle a 20-MHz 80387SX math coprocessor ($849). A RAM upgrade to 5MB is available for $2,199; the RAM in our evaluation system was rated at 80 nanoseconds. System and video BIOS shadowing, both of which can be disabled through setup software, is provided, as is intelligent docking. There are enough ports on the system to accommodate one serial device, one parallel printer, a separate numeric keypad, and a full-size color monitor.

NEC wants the SX/20 to be considered in the same league as similar offerings from Compaq.

The paper-white, 6- by 8-inch backlit LCD screen offers a maximum pixel resolution of 640 by 480 and displays 16 shades of gray. Absent is the visible streaking of the 386SX's screen, and its speed is better than that of previous Pro-

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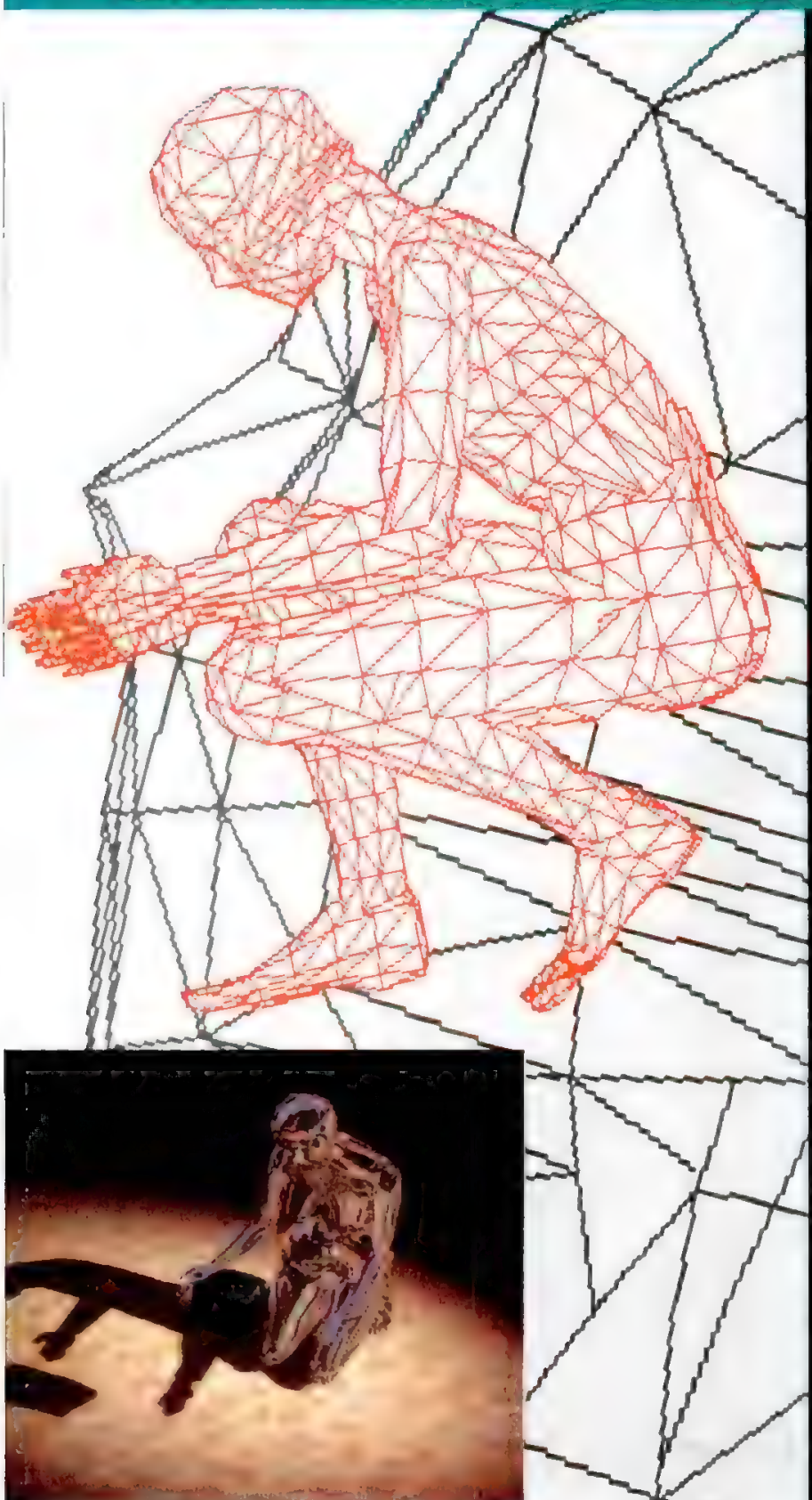

Image created by Gary Yost. Mannequin was exported via DXF into Autodesk 3D Studio®

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Twice the value and ready to roll. Your new Superlap comes complete with MS-DOS 4.01, user guides, external AC adapter and an attractive Twinhead carry bag. PC Week* says the Superlap "scores magnificently...is well-made and bargain-priced." Call today to order your Superlap information packet.

	Twinhead Superlap 386SX/20	Compaq SLT 386s/20
Video Grey Scale	32 shades	16 shades
Disk Drive	40 MBytes	60MBytes
Total Weight	12 lbs.	14 lbs.
Warranty Support	One year	One year
Retail Price	$3,495	$6,799*

1-800-545-TWIN West Coast
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CIRCLE 310 ON READER SERVICE CARD

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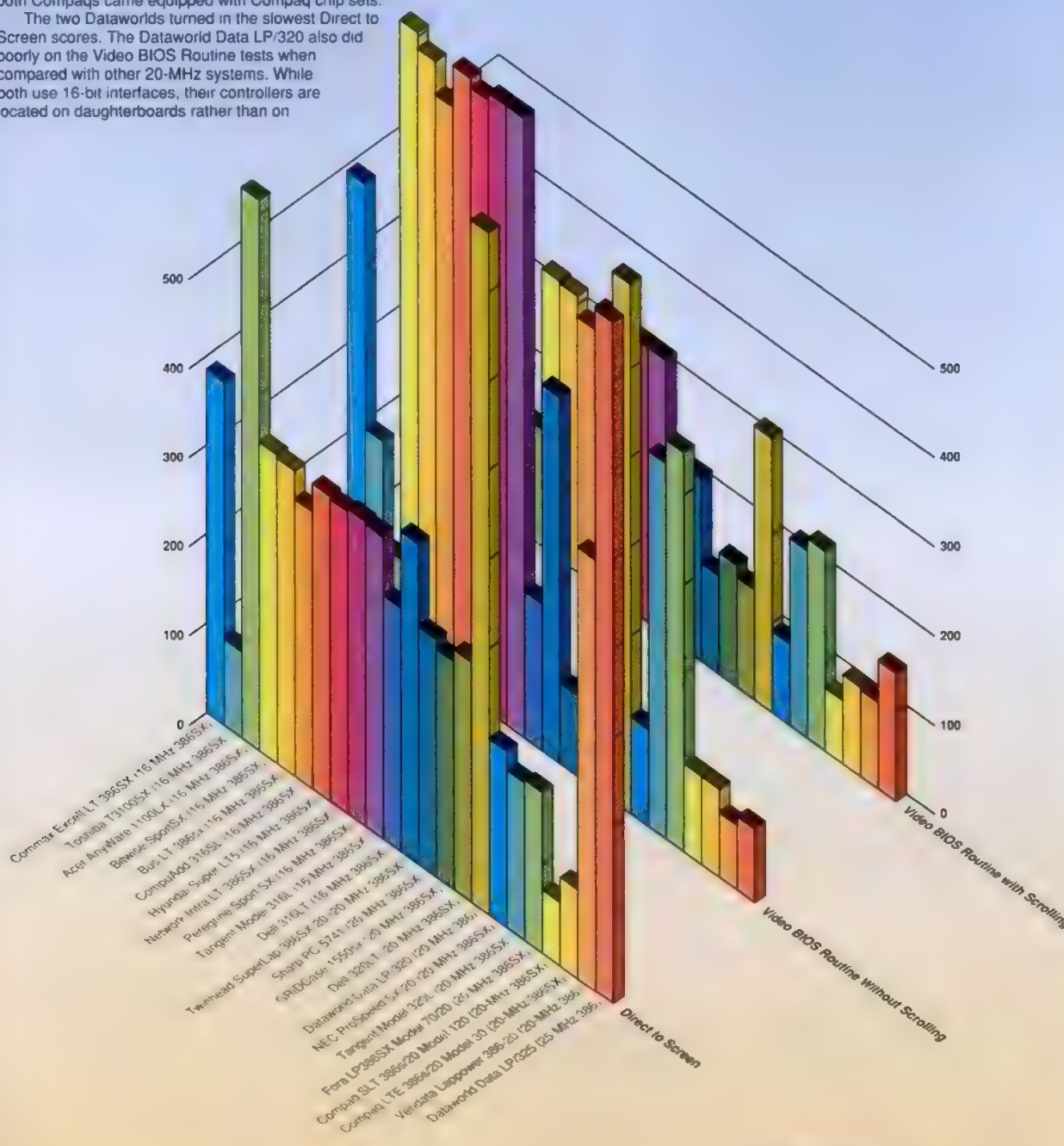
VIDEO BENCHMARK TESTS: COMPOSITE VIEW

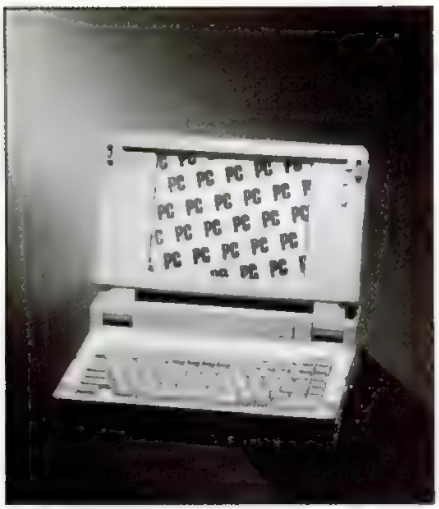
Three systems turned in excellent times on the Direct to Screen tests: Compaq's 20-MHz SLT 386s/20 and LTE 386s/20 and the 16-MHz Toshiba T3100SX. All three had 16-bit interfaces with video on the motherboard. The Toshiba used a Paradise chip set, while both Compaqs came equipped with Compaq chip sets.

The two Dataworlds turned in the slowest Direct to Screen scores. The Dataworld Data LP/320 also did poorly on the Video BIOS Routine tests when compared with other 20-MHz systems. While both use 16-bit interfaces, their controllers are located on daughterboards rather than on



Relative Times
(Compaq LTE 386s/20 Model 30 = 100)

ENDS



NEC ProSpeed SX/20, $6,198

Speed models. The company attributes the gain to a new Cirrus Logic chip set. The downside is that the SX/20's screen cannot be run simultaneously with an external monitor.

With the full complement of power supplies—battery and AC adapter/charger, plus cords—the whole package weighs nearly 15 pounds. If you're averse to risk and like to carry an extra battery ($199), you'll find the SX/20's recharging system inconvenient. For it to be recharged, the battery must be in the laptop. This means that carrying a spare nickel cadmium brick won't do you much good unless you can do without the laptop while it recharges the batteries (requiring 2 hours for each brick with the laptop off) or can find a convenient outlet.

On PC Magazine Labs' Battery Rundown test, the SX/20's battery ran about 28 minutes shy of its claimed 3-hour life span. To help reduce the electric bill, power conservation options on the system include screen blanking, disk power-down, and system power-down.

If you're counting on this laptop to be your only work terminal, you'll probably want a larger hard disk. Indeed, in our benchmark tests, the only perceptible shortfall was in hard disk performance. Unfortunately, a 40MB PrairieTek IDE hard disk drive is all NEC offers at present. The company plans to introduce an 80MB upgrade this spring.

For those of you who refuse to relinquish expandability, NEC's $1,199 docking station allows you to anchor the SX/20 to your desk automatically configured. The expansion chassis gives it two full-size 16-bit slots, two phone-line jacks, a port for a monitor, and one parallel and two serial ports. If the station's two 16-bit cards must travel, you can take the unit—lock, stock, and docking station—along with you. It has a convenient carrying handle, but an inconvenient weight increase of 15.4 pounds, making for a grand total of over 28 pounds.

If you do opt for the docking station, you will appreciate the unit's detachable keyboard. Its 83 keys are smooth and fluid, if just a little bit lacking in crispness. Tentative touch typists will appreciate the position-correcting bumps that have been put on the F and J keys.

NEC may not provide very much in the way of hard disk choices, but it does offer a couple of attractive options: a 2,400-bit-per-second ProSpeed Modem for $399 and a 2,400-bps Image Modem Plus with MNP 5 error correction for $699. The "Plus" is a 9,600-bps fax, which is particularly handy for executing on-the-road invoices. NEC also offers a car battery adapter for $25.

For true home away from home computing, NEC offers a toll-free technical support line. With good documentation, considerate design, and top-notch performance, this machine has much of the stuff of desktop computers. And given its substantial list price, NEC clearly wants the SX/20 to be considered in the same league as similarly configured offerings from Compaq. Now it deserves to be considered as such.

FACT FILE

NEC ProSpeed SX/20
NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 800-826-2255, 508-264-8000.
List Price: With 1MB RAM, 40MB hard disk, VGA backlit supertwist nematic LCD, 1.44MB floppy disk drive, DOS 4.01, EMM 4.01, disk caching software, $5,999.
Options: 1MB RAM upgrade, $399; 4MB RAM upgrade, $2,199; 80387SX math coprocessor, $849; 2,400-bps modem, $399; 2,400-bps MNP 5, V.42 bis modem with 9,600-bps fax capability, $699; extra battery, $199; car battery adapter, $25; expansion chassis, $1,199; external disk drive, $495, carrying case, $139.
In Short: A solid, capable 20-MHz SX laptop with more than intelligent docking; it also has intelligent design. Look at this NEC offering with desktop use in mind. It has the power you might need and the clear display you want, though at 12.8 pounds, it's a little too heavy for easy transportability.

CIRCLE 608 ON READER SERVICE CARD

NETWORK PC

Intra LT-386SX

by Michael Cohn

Sometimes a distributor can make a difference. In the case of several Sotec-designed 16-MHz 80386SX-based systems reviewed in this roundup, the difference lies mostly in the peripherals that come with the machine or that are offered as options.

Network's Intra LT-386SX, $2,499.

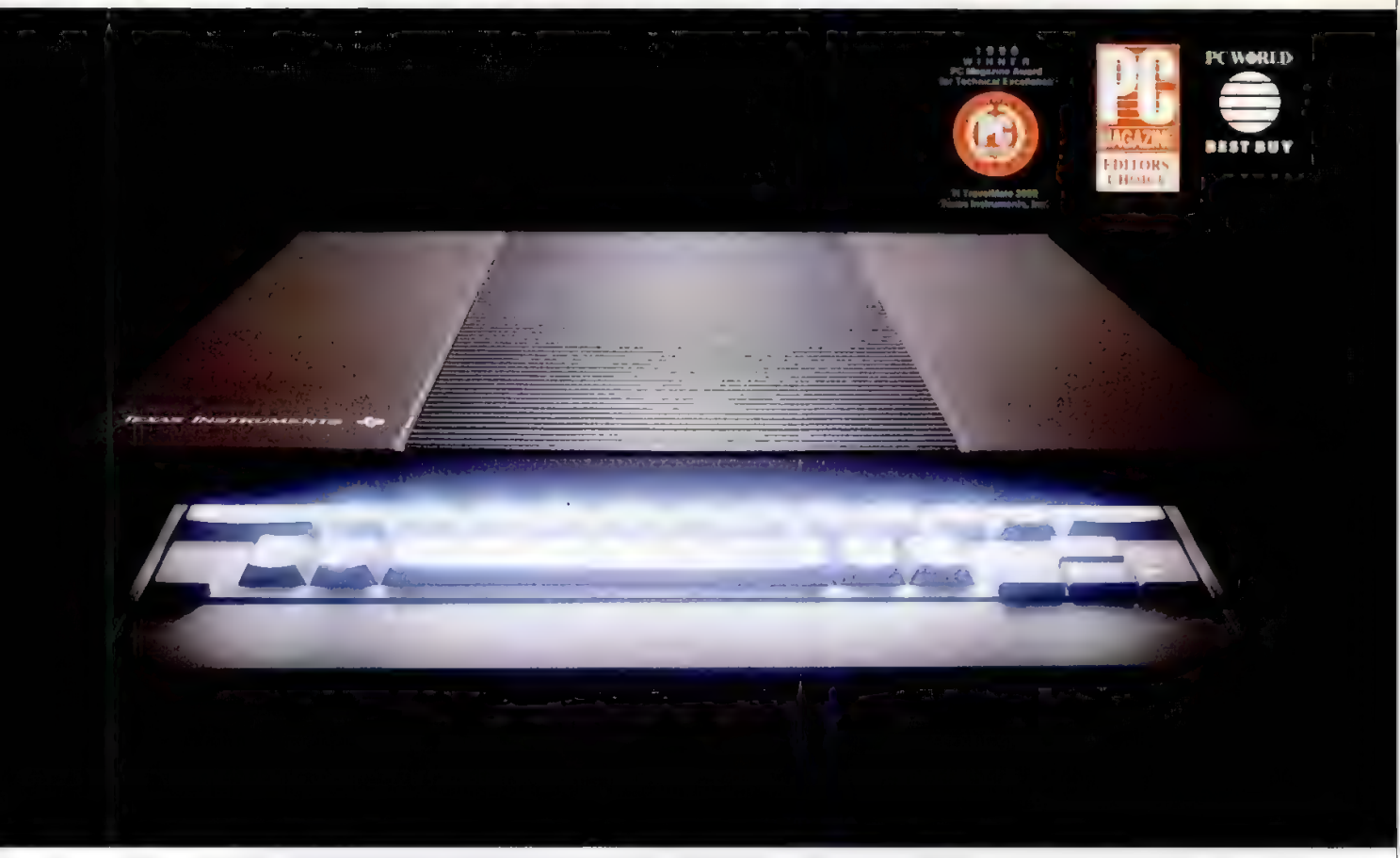
Six other vendors sell essentially the same laptop as Network PC's Intra LT-386SX with some extra peripherals for slightly more money. But when you order from Network PC, you get the DOS of the future, Digital Resources' $199 DR-DOS.

For a list price of $2,499, the Intra LT-386SX provides a readable 7- by 5.3-inch VGA display that takes advantage of supertwist, backlit monochrome LCD technology and configurable gray scaling. The machine also includes a fast, 40MB Alps IDE hard disk, a 1.44MB floppy disk drive, and a port for an optional external floppy. The 11.4-pound unit comes with 2MB RAM in 100-nanosecond 1-megabit DIP chips, expandable to 6MB.

The LT-386SX offers more memory than its RAM capacity suggests. Since the machine comes with DR-DOS, you can preview several features promised in MS-DOS 5.0, notably its enhanced memory management. When DR-DOS boots up, it moves device drivers, TSRs, and its own kernel into high memory, leaving more conventional memory available for programs.

The Intra's 2.5- by 12.5- by 12.3-inch case is sturdy enough to withstand the

The new look of power.



286 processing in a computer that's notebook size, 1.4" thin and 4.4 lbs. light.

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Since inventing the first portable data terminal in 1969, TI has led the way in packing more and more functionality into smaller and smaller products. Now TI brings you the next generation in portable computing — the TravelMate 2000.

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The TM 2000 has the power to run your favorite software — 12 MHz 80C286 processor, 20MB hard disk drive and 1MB of RAM. A built-in, rechargeable battery lets you work up to two hours. With an optional add-on battery, you can work up to five hours — enough for coast-to-coast flights.

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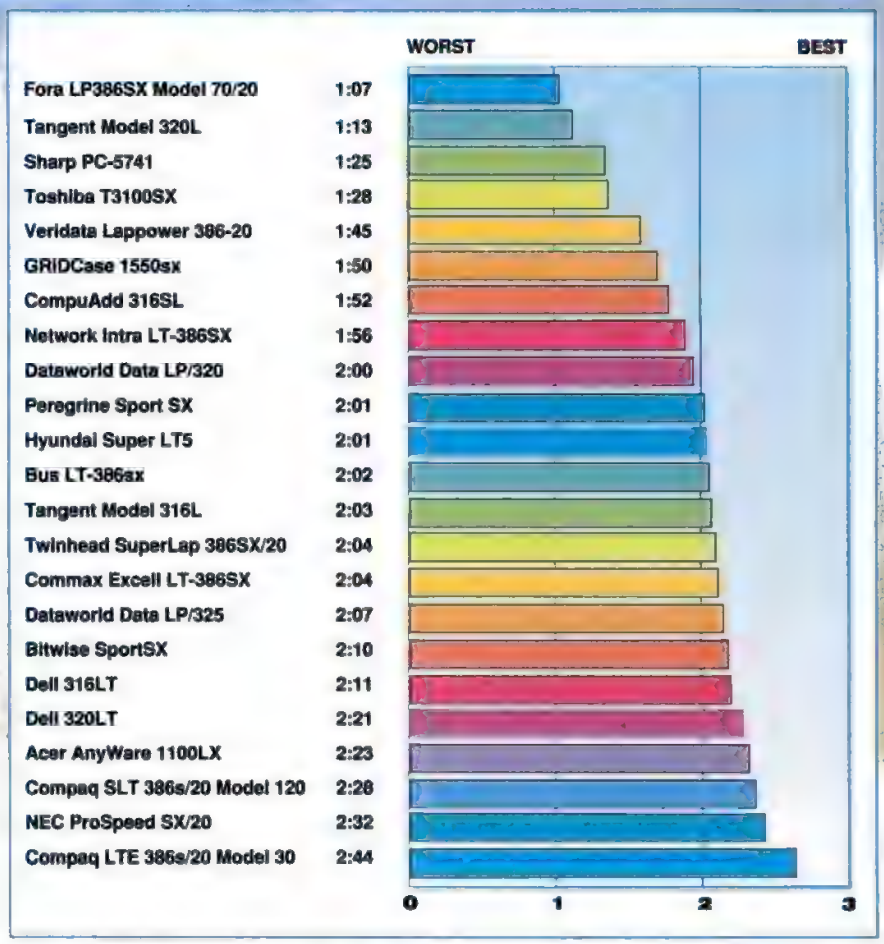
PERFORMANCE TESTS: BATTERY-POWERED 386-BASED PORTABLE PCs

The Battery Rundown performance test involves teletyping five screens of text to the laptop computer's display and writing a 15K file to the hard disk, once every minute until the battery runs out of power. All power conservation techniques are disabled.



The Compaq LTE 386s/20 Model 30, the lightest system we reviewed, used a 1.7-Ah battery (the lowest Amp-hour rating tested) but still produced the best battery rundown time in this group: 2 hours 44 minutes.

The Toshiba T3100SX turned in a time that fell short of its claim by more than half. On the other hand, it generally runs on two batteries, while we tested all systems with one.

The two 386-based Dataworld models turned in fine rundown times, thanks to their 4.5-Ah batteries. Though Dataworld says that the batteries should last only 1 hour, both systems produced times around the 2-hour mark, with the Dataworld Data LP/325 besting most of the 386SX systems.

shocks it's likely to meet in transit. Inside, you'll find a 16-MHz 80386SX processor along with a Sotec motherboard and chip set. The system lacks a processor RAM cache, but its AMI BIOS allows for video and system BIOS shadowing. A proprietary modem slot is the sole internal expansion option, and Network PC sells a $215 2,400-bit-per-second fax/modem board to fit it. An optional 80387SX math coprocessor, which fits into a socket on the motherboard, costs $399.

Like the machines from Peregrine and Tangent, the Intra LT-386SX comes with an 85-key keyboard. Most of the keyboard's 12 function keys are arrayed in a line across the top. The cursor keypad is located in an unusual place, at the top right-hand corner of the keyboard, but pressing the NumLock key enables an embedded keypad that's more convenient to use. Two feet at the base of the unit help change the keyboard's angle.

The Intra LT-386SX offers power-saving features such as screen-blanking and disk power-down options. When power is running low, a battery indicator above the keyboard flashes red, and the machine beeps when there is only a quarter to a half hour of battery life left. Network PC rates the machine's nickel cadmium battery at 3 hours, but on our Battery Rundown test it lasted only 1 hour 56 minutes. Since we disable all power-saving devices before we run the batteries down you'll probably get better time out of your system. It takes 8 hours to recharge the battery with the system on and 4 hours with it off. A 1.8-pound external SportSX power supply comes with the system, and Network PC sells an extra battery pack for $74.

In most of our other benchmark tests, the Intra LT-386SX, like its counterparts with other labels, was among the slowest performers. It did place near the top of the pack on our BIOS Disk Seek test, however, and around the middle on our Direct to Screen video test. If your applications use track-to-track disk accesses frequently (as database programs do), the LT-386SX may be a good choice.

Network PC's entry provides most of the features users of 80386SX-based portables expect to find, and it is backed by a

FACT FILE

Intra LT-386SX
Network PC, 5020 NW 39 St., Lincoln, NE 68524; 800-873-9235, 402-470-3446.
List Price: With 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA display, external floppy disk port, $2,499.
Options: 2MB upgrade, $150; internal 2,400-bps fax modem, $215; external 2,400-bps pocket modem, $159; 80387SX coprocessor, $399; battery pack, $74; AC car battery adapter, $74; external 1.2MB floppy disk drive, $199; carrying bag, $59.
In Short: The Intra LT-386SX, distributed by Network PC, furnishes enough power and battery life to satisfy most users. The monochrome screen is fairly readable, and the bundling of DR-DOS is an interesting touch. While its benchmark test scores are middling, its low price makes it an attractive bargain.

CIRCLE 609 ON READER SERVICE CARD

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The new TravelMate™ 3000 notebook computer packs 386™SX power into 1.8" and 5.7 lbs.

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one-year parts-and-labor warranty and toll-free technical support. It offers serviceable power at a reasonably inexpensive price.

PEREGRINE COMPUTERS

Peregrine Sport SX

by M. David Stone

Given that the Peregrine Sport SX from Peregrine Computers is the same system sold by Bitwise (the SportSX), Bus Computer Systems (the Bus LT-386SX), CompuAdd (the 316SL), Network PC (the Intra LT-386SX), and Tangent Computer (the Model 316L), all of which are reviewed in this roundup, phrases like "peas in a pod" immediately come to mind. What distinguishes each of these systems from the others is its particular mix of price, options, and vendor support.

Equipped to meet our standard configuration, with 2MB of RAM, a 40MB hard disk, a 1.44MB Epson floppy disk drive, and a backlit supertwist VGA LCD, the Peregrine Sport SX lists for $2,699, just slightly less than Tangent's price for its essentially identical system. Peregrine also throws in three notable extras: a Logitech serial mouse, *Microsoft Windows* 3.0, and DOS 4.01.

These extras aside, the Sport SX is another, well, pea in the pod, with measured

Peregrine Sport SX, $2,699.

performance on the same level as the machines mentioned above. The 2.5- by 12.5- by 12.3-inch unit weighs under 12 pounds with the removable battery pack, or just over 13 pounds with the AC adapter. The fully charged battery has a measured life in our tests of about 2 hours, and a claimed recharge time of 8 hours with the system on or 3.5 hours with the system off.

Connectors on the Sport SX include a parallel port, a serial port, an AT-style keyboard connector, and a high-density DB-15 for an external display. There is also a connector for an external 1.2MB floppy disk drive, a $249 option.

The inside of the Sport SX is identical to that of the other Sotec-based systems. All key components are on the Sotec system board, including a 16-MHz 80386SX chip, a socket for an 80387SX math coprocessor, a Sotec chip set, a Sotec VGA video chip set, and an AMI BIOS. The system provided for review came with 2MB of DIP-type RAM installed on the motherboard, using 100-nanosecond 1Mb chips. Four SIMM sockets can each accept a 1MB SIMM, yielding a maximum system RAM total of 6MB. The hard disk in the review unit was a 40MB IDE Alps with an 18-millisecond average access time.

Compared with other versions of the same computer, the Sport SX suffers from a paucity of options and from including *Windows* and a mouse in its base price.

Peregrine has fewer options for the Sport SX than other vendors of similar systems. For example, you're limited to the Sport SX's 40MB Alps IDE hard disk, and the only modem option is a no-frills 2,400-bit-per-second unit for $189. RAM upgrades are $120 per 2MB, and an 80387SX math coprocessor costs $299.

The Peregrine Sport SX's backlit supertwist LCD screen is readable. At the same time, it is noticeably weaker in brightness and contrast than that of the Dell 320LT, for example.

The machine's 85-key keyboard has a similar feel to that of Toshiba portables.

FACT FILE

Peregrine Sport SX
Peregrine Computers, 110 East Canal St., Troy, OH 45373; 800-326-7015, 513-339-3151.
List Price: With 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 4.01, *Microsoft Windows* 3.0, Logitech serial mouse, $2,699.
Options: 2MB RAM upgrade, $120; 2,400-bps modem, $189; math coprocessor, $299; extra battery, $69; external floppy disk drive, $249.
In Short: Peregrine loads its 386SX/16 with *Windows* and a mouse, but this machine suffers from the same design flaws as other Sotec systems: oddly placed cursor keys, average performance, and dull screen contrast. Peregrine offers fewer options than several other vendors.

CIRCLE 610 ON READER SERVICE CARD

Alas, the keyboard layout is idiosyncratic (unless you count the other Sotec systems with the identical keyboard). The arrow keys are on the top right, which may take some getting used to. Similarly, PgUp, PgDn, and a few other keys are situated in odd places.

All told, the Sport SX is a reasonable choice among battery-powered 80386SX-based systems. But compared with other versions of the same computer, it suffers somewhat from a paucity of options and from the inclusion of a mouse and *Windows* in its base price. If you don't need those two items, or if you'd rather have a larger hard disk, a combination fax/modem, or some other option that Peregrine doesn't offer, you can look elsewhere to find the same basic computer and better-suited add-ons.

SHARP ELECTRONICS CORP.

Sharp PC-5741

by Greg Pastrick

Looks do make an impression. On first view, the Sharp PC-5741's specs scream out at you from a huge red, black, and gold sticker attached to the top of the laptop's gray case. So does its sticker price—$5,495 for this 20-MHz 80386SX system with 2MB of RAM, a 40MB Conner IDE hard disk, a 1.44MB 3.5-inch floppy disk drive, a VGA display, and DOS 4.01.

The Sharp PC-5741 measures 2.8 by 11.8 by 13.4 inches and weighs 13.4 pounds; an AC adapter adds another 1.5 pounds. Compared with the smaller-profile 80386SX-based laptops in this round-

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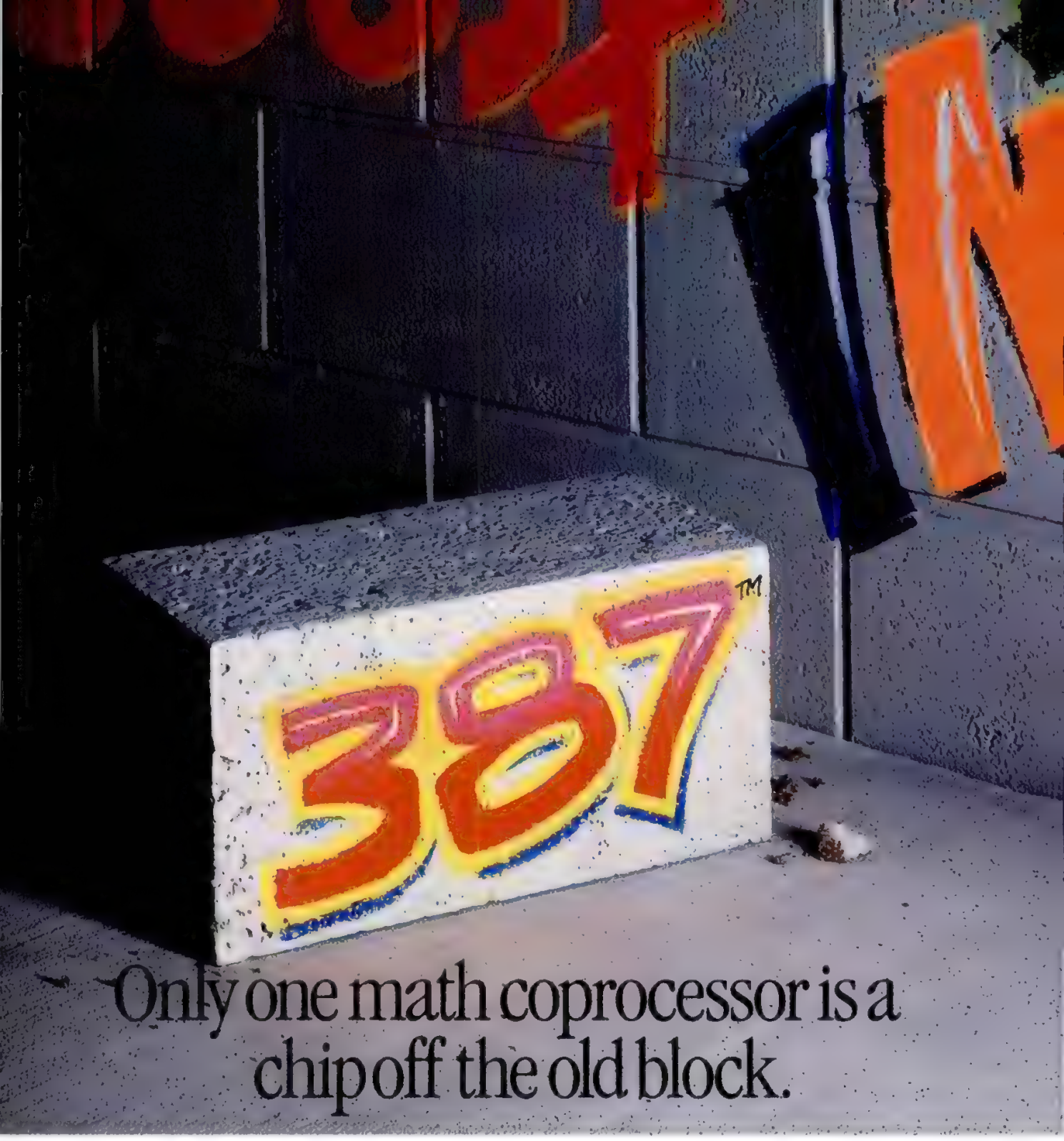
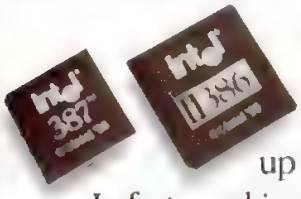
to speed up your
power applications.
There's just one more thing
you should know.



Only one math coprocessor is a chip off the old block.



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Sharp PC-5741, $5,495.

up, the PC-5741 gives the impression of a large and heavy portable.

Inside, the Sharp motherboard holds an 80386SX processor and a socket for an Intel 80387SX math coprocessor. The system uses a Chips and Technologies chip set and a Phoenix BIOS. The motherboard holds a maximum of 2MB of RAM, which in our evaluation unit consisted of 80-nanosecond 1MB SIMMs. You can expand RAM to 12MB for $799 per 2MB with a proprietary RAM card, which you install in a hatch on the bottom of the case.

Along the left-hand side of the Sharp is a row of ports and plugs for serial, parallel, and expansion devices, and two display interfaces labeled analog and digital. In addition, this array includes space for dual RJ-11 jacks for the optional $499 internal 2,400-bit per second modem and an add-on serial port. Also on the left panel are an LCD/CRT toggle and an exposed bank of DIP switches.

The reason for the unusual placement of these connectors and controls is that Sharp offers an optional $399 battery pack that snaps on to the back of the laptop. The extra battery pack (which was not provided for review) is rated to extend power for 3 hours beyond the 2 hours claimed for the internal nickel cadmium set. The standard battery pack offered 1 hour 25 minutes of power on PC Magazine Labs' Battery Rundown test.

The Sharp's right panel holds the brightness and contrast wheels, screen reverse control, a PS/2 keyboard adapter, AC jack, and power switch. Because of the need to accommodate the external battery pack, the machine's reliance on side panels is understandable, but it is still not desirable.

The PC-5741's double supertwist nematic display has a maximum pixel resolution of 640 by 480 and can display 16 shades of gray. Its performance on PC Labs' Video BIOS Routine tests was better than average for the group. The quality of the 6- by 8-inch screen is not close to paper-white, but its brightness and contrast make it better than average.

The PC-5741's 79-key keyboard, including embedded numeric keys, seems expansive. The keys are large and they are well-spaced, and there's a good feel to the action of the keys. The 12 function keys line up across the top of the keyboard. Sharp's set-up program can be activated from an appropriately labeled proprietary Setup key.

The Sharp's 40MB IDE drive, rated for 25-millisecond access, actually did better than its advertised performance on our disk performance tests; overall, however, its disk speeds were average for the group. Sharp includes a disk-caching utility with the machine, but it was not loaded for testing. The DOS file access and conventional memory tests yielded more competitive results.

Sharp doesn't offer a wide range of hardware options beyond those already mentioned and two types of carrying case, but it does provide a number of software utilities with the PC-5741. These include power-conservation, memory-management, and diagnostic utilities. All can be enabled independently of the setup routine.

With a readable screen, a decent keyboard, and expandable memory, the Sharp PC-5741 is an acceptable choice. But it still bucks the trend for lighter, slimmer, more easily transportable laptops at matching or lower prices.

FACT FILE

Sharp PC-5741
Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430; 201-529-9500.
List Price: 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA LCD system, DOS 4.01, $5,495.
Options: 2MB RAM upgrades, $799; 2,400-bps MNP 5, V.22 bis modem, $499; extra battery, $399; AC adapter, $189; expansion chassis, $699; external floppy disk drive, $299; numeric keypad, $99; nylon carrying case, $75; leather carrying case, $199.
In Short: The 20-MHz 80386SX-based Sharp PC-5741 is a basic laptop with the right memory and hard disk capacity in the wrong case. It bucks the trend for lighter and slimmer power portables and has some undesirable design points.

CIRCLE 611 ON READER SERVICE CARD

TANGENT COMPUTER INC.

Tangent Model 316L

by M. David Stone

The Tangent Model 316L is yet another incarnation of the Sotec-designed 16-MHz 80386SX system sold by Bitwise, Bus Computer Systems, CompuAdd, and Network PC. Tangent Computer's list price for this ubiquitous system is about mid-range for this group: $2,768 for *PC Magazine*'s standard configuration, including

Tangent Model 316L, $2,768.

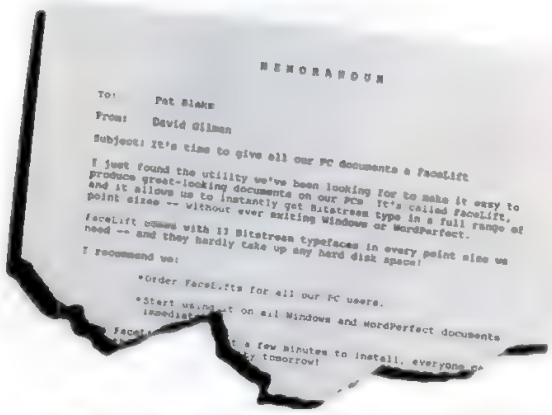
2MB of RAM, a 40MB Alps IDE hard disk, a 1.44MB Epson floppy disk drive, and a VGA display. In its basic configuration without DOS, the system costs $2,690.

Physically, the 316L is identical to its brethren, measuring 2.5 by 12.5 by 12.3 inches and weighing under 12 pounds complete with its removable battery pack. Even with the 1.9-pound AC adapter, the package weighs only a little over 13 pounds. With a fully charged battery, the 316L ran for about 2 hours in our Battery Rundown test. The claimed recharge time is 8 hours with the system on, 3.5 hours with it off.

Connectors on the back of the machine include one parallel port, one serial port, one high-density DB-15 for an external VGA display, and a port for Tangent's $185 optional 1.2MB external floppy disk drive. In addition, you'll find an AT-style

Before

Until now, many desktop publishers found it too time-consuming to use the right typefaces and point sizes. Unfortunately, the end result was often too plain-looking for potential readers.



This memo, using one face in one size, looks fairly decent. But why settle for "fairly decent" when FaceLift will instantly make your Windows or WordPerfect documents look "absolutely great!"

After

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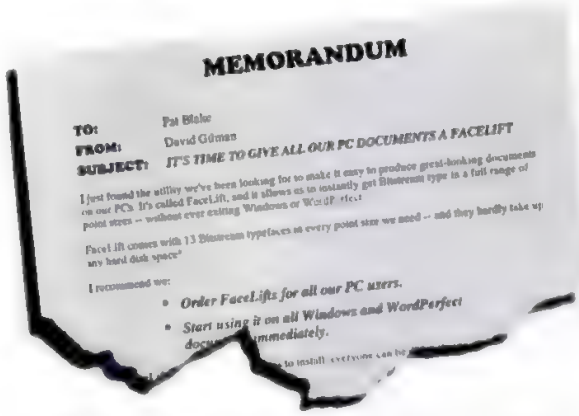

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Formal Script 421

Park Avenue™

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Bitstream

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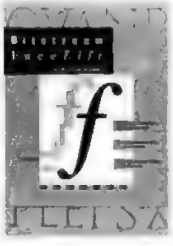

FaceLift for Windows

FaceLift for WordPerfect

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CIRCLE 131 ON READER SERVICE CARD

FACT FILE

Tangent Model 316L
Tangent Computer Inc. 197 Airport Blvd., Burlingame, CA 94010; 800-223-6677, 415-342-9388.
List Price: With 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, backlit VGA display, DOS 4.01, $2,768.
Options: 4MB RAM upgrade, $280; upgrade to 100MB hard disk, $295; 2,400-bps modem, $179; combination fax/modem, $389; 80387SX coprocessor, $359; extra battery, $90; numeric keypad, $24; external floppy disk drive, $185.
In Short: Yet another incarnation of the Sotec-designed system sold by Bitwise, Bus, CompuAdd, Network PC, and Peregrine, the Tangent Model 316L shares the same acceptable screen and idiosyncratic keyboard layout, along with a Toshiba-like keyboard feel. Tangent charges a little more than some of the others, but don't rule it out if Tangent's set of options matches your needs.

CIRCLE 617 ON READER SERVICE CARD

keyboard connector on the side panel.

Inside the box is the standard fare for these systems. Mounted on the Sotec system board are a 16-MHz 80386SX chip, a socket for an 80387SX math coprocessor, a Sotec chip set, a Sotec VGA video chip set, and an AMI BIOS. As tested, the system had 2MB of 100-nanosecond DIP RAM, using 1-megabit chips. Four SIMM sockets provide room for up to four 1MB SIMMs, yielding a maximum of 6MB of RAM for the system.

Tangent's set of options includes RAM upgrades ($280 for 4MB), a 100MB hard disk ($295), a 16-MHz 80387SX coprocessor ($359), a 2,400-bps modem ($179), and a combination fax/modem ($389). Neither modem offers MNP, V.42, or V.42 bis. The combination fax/modem has a top speed of 2,400 bits per second for data, but only 4,800 bps for faxing. The modem slot in the back of the system is easy to get at, so you'll have no trouble installing the modem yourself.

As with all of the Sotec systems, the supertwist LCD includes backlighting for better readability. Although the screen does not offer as much brightness or contrast as, for example, that of the Dell 320LT, you're likely to find it acceptable.

The feel of the Tangent 316L's 85-key keyboard is reminiscent of that of Toshiba portables. You may have to take some time before you feel comfortable with its layout, with the arrow keys on the top right, and with PgUp, PgDn, and other keys in odd places.

Ultimately, the question you'll have to ask about the 316L is not whether the system is worth considering. It is. Rather, why buy it from Tangent, rather than from, say, CompuAdd? The answer is that unless Tangent's options closely match your needs, there really isn't a compelling reason to pick this vendor over the others.

TANGENT COMPUTER INC.

Tangent Model 320L

by M. David Stone

Contrary to what you probably expect, Tangent Computer's 20-MHz 80386SX-based Model 320L is not simply a faster version of its 16-MHz Model 316L. In fact, the two systems have only one thing in common: Neither is unique to Tangent. You'll find essentially the same computer, the Fora LP386SX Model 70/20, reviewed elsewhere in this issue.

Unique to Tangent is a low list price. Equipped to meet *PC Magazine*'s standard configuration for this roundup, including 2MB of RAM, a 40MB hard disk, a 1.44MB floppy disk drive, a backlit supertwist VGA LCD, one parallel and two serial ports, and DOS 4.01, our tested unit costs $2,890, making it substantially less expensive than its $4,699 counterpart from Fora. With 1MB of RAM, the base price of the 320L is $2,725. Tangent's system is distributed directly, while Fora's is sold by retailers.

The Tangent Model 316L and the Model 320L have only one thing in common: Neither is unique to Tangent.

Included in the list price of our evaluation unit is a $165 1MB RAM upgrade card. Tangent also sells a 4MB card for $495, for a maximum system total of 5MB of RAM. You cannot upgrade the 1MB card to 4MB, but must replace it. If within 90 days of purchase you decide that you bought the wrong card, Tangent offers a trade-in option, with full credit toward the price of the 4MB card.

Tangent Model 320L, $2,890.

The version of the 320L we tested weighs 14.8 pounds (including the battery), or 0.3 pounds more than the review unit from Fora. Except for this slight difference in weight and for the color of the case, Tangent's entry is identical to Fora's. Since its measured battery rundown time was about 1 hour 13 minutes, you should plan on carrying the 2.1-pound AC adapter with you at all times.

Best described as an oversize laptop, the 320L measures 3.3 by 12.8 by 16.1 inches. Hidden under its back panel are two half-length 16-bit slots, affording you a reasonable amount of expandability. Inside the chassis is the same Chaplet motherboard as in the Fora Model 70/20. Components on the board include a 20-MHz 80386SX processor, a Chips and Technologies chip set, an AMI BIOS, a Cirrus VGA video chip set, and a socket for an 80387SX math coprocessor.

As with the Fora unit, one of the machine's two serial ports uses a 9-pin DIN connector and is meant for a mouse; there is also a parallel port. And like Fora, Tangent supplies an adapter cable with a DIN connector on one end and a male DB-9 on the other.

Memory in the review unit consisted of 80-nanosecond DIP chips, with 1MB on the system board and 1MB on the optional memory card. The hard disk was a 40MB Conner IDE drive, complete with its own controller. All of these details match those of the Fora machine. Tangent's only other recommended hard disk is a 100MB Conner unit, which costs $295 more than the 40MB device.

As with the Fora LP386SX Model

A few expert opinions:

"There's a new king of the hill–the ZEOS Notebook..." – PC Magazine ■ *"This notebook is a steal."* – InfoWorld ■ *"In this category I'm most impressed with the ZEOS Notebook...it has to be the number one contender."* – John C. Dvorak ■ *"The best price performer in its category."* – Mobile Office ■ *"An outstanding value."* – PC Week ■ *"Impressive"* – PC Sources

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'286 AND 386SX

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Your new ZEOS notebook is a great connectivity tool. Utilizing our optional built-in 2400 baud MNP Class 5 modem, connectivity buffs will find themselves logging on at every turn. And speaking of connectivity, we've kept the I/O easy to use too. Because unlike many of the others, your new ZEOS notebook has the same industry standard port connectors you'll find on your larger desktop system. Completely compatible! Serial and Parallel ports; even an external VGA connector. All industry standard and ready to go the minute you receive your system.

It's attention to detail that makes the difference. Tens of thousands of hours of development time have been invested. We've been thinking and re-thinking exactly what you want in a notebook, and now we're building it for you. We think you'll agree, it's an incredible product. Plus, your new notebook is backed by the best support in the industry, 24 Hours a Day.

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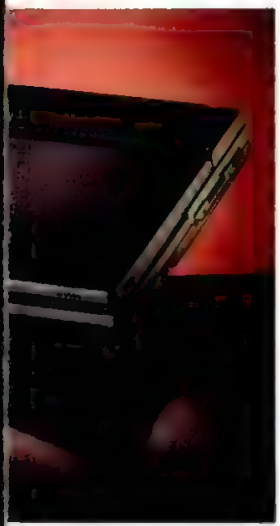

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The ZEOS Guide to the Perfect Notebook:

PROCESSOR: PC Magazine recommends a '286 or '386SX processor pointing out that "8086- and 8088-based portables have only half to a third of the computing power of a 286." That's why ZEOS offers you your choice, '286 or 386SX! More power for you. After all it's just like a 6.5 pound desktop!

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VIDEO: ZEOS raises the ante to VGA! We're talking about bright and crisp VGA displayed on one of the largest notebook screens in the industry. The display also features advanced fluorescent backlighting, 32 grey scales and 640 x 480 resolution. Plus, it can be adjusted to any position over a 135° angle and features easily adjustable brightness and contrast controls. Easy viewing under virtually any lighting conditions. You can connect to an external VGA color monitor too!

GREAT BATTERY FEATURES: Every battery feature you want. You can plug your notebook in and "quick charge" the battery in less than one hour or you can "trickle charge" while in use. Plus, your battery easily snaps out allowing the quick installation of an optional replacement battery. It's great to be able to carry a light weight spare for those especially long trips. An optional battery charger stand is available as well.

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CHECK IT OUT!

Now, you can take desktop computing power anywhere! Your ZEOS notebook has many features of obvious importance. Also, there are a number of features that are subtle yet critical to your ultimate satisfaction. We'll go over them here one by one. We think you'll agree your new ZEOS Notebook is the one for you!

SYSTEMS STATUS AT A GLANCE: Yes, monitor eight key system components at a glance! We've equipped your new notebook with eight LED indicators which monitor disk access, keyboard functions and power status. There is even an audible alarm which may be programmed to inform you of a low battery condition and to let you know if the cover is closed with the power on. Now that's one smart notebook!

DESKTOP KEYBOARD FEATURES: We're talking 82 full size keys with full 101-key emulation. And the keyboard isn't squeezed either. The distance between the "Q" key and the "[" (left bracket) key measures 7.5 inches, just as PC Magazine suggests. The keys are of standard size, plus touch typists will love our full 3.5mm keystroke. Type for hours and love it!

CONNECTIVITY AND I/O: Keeping in touch is easy when you order our internal 2400 baud MNP Class 5 modem. Simply plug in the phone line and dial away. How about I/O ports? Many notebooks don't have them and if they do they're often non-standard. But your ZEOS notebook has *industry standard I/O*—serial, parallel and VGA. Just like your desktop!

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Foldout slip-sheet

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4. Close the page and slip-sheet

Inverted Foldout slip-sheet

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    1. Front side touching the free page
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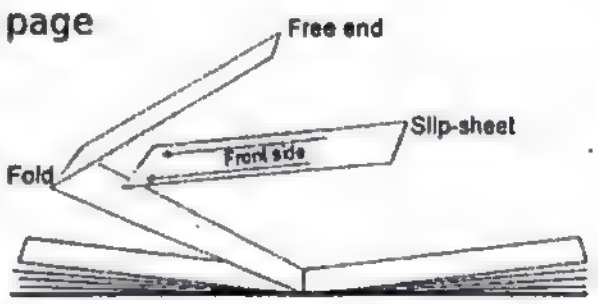

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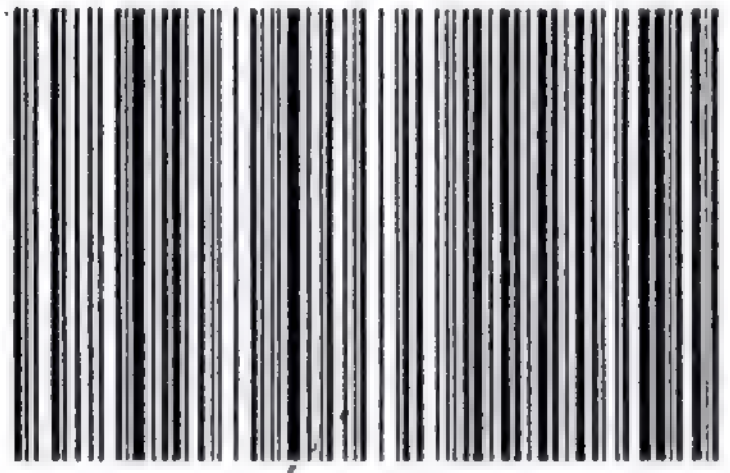

Back

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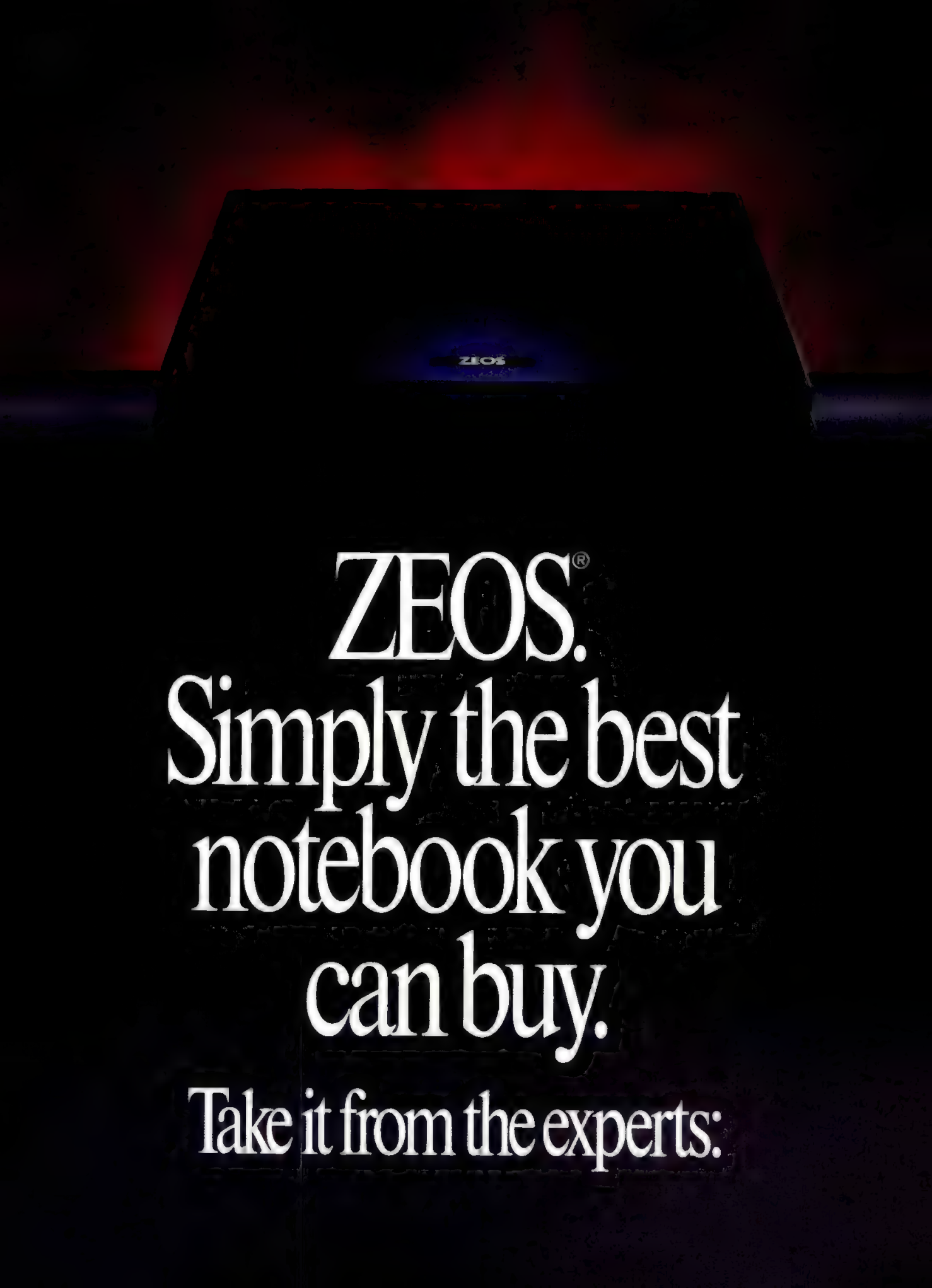
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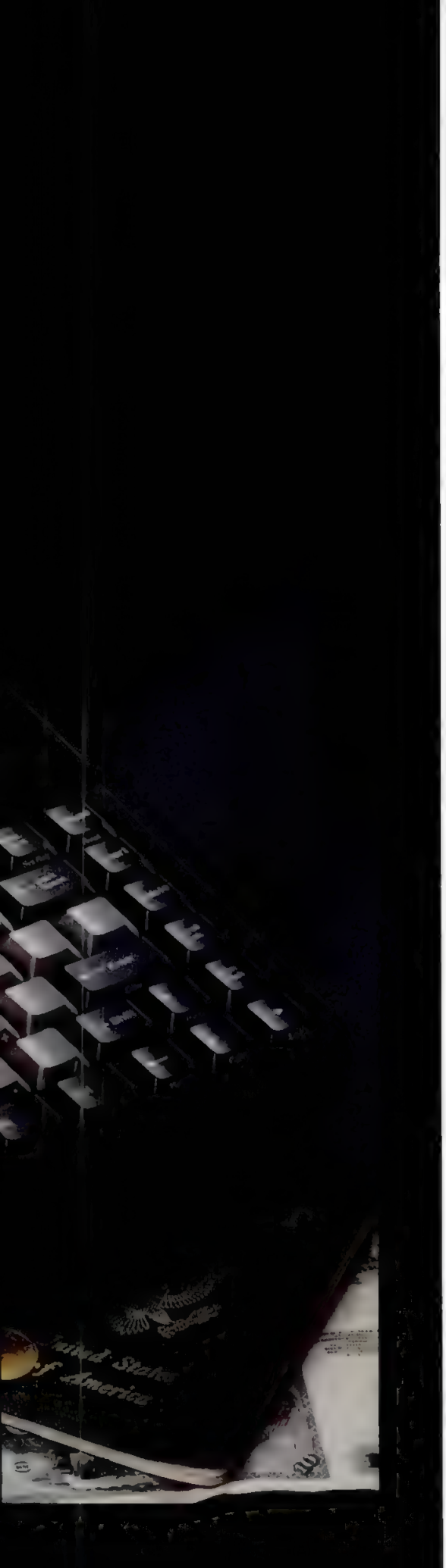

ZEOS NOTEBOOK

"THERE'S A NEW KING OF THE HILL"
—PC MAGAZINE

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INCREDIBLE DESKTOP FEATURES IN A NOTEBOOK.

In fact, it's really like owning a 6.5 pound desktop that you can take with you anywhere! Look closely at the details. Like our crisp 10″ VGA display. The ultimate in sparkling clarity, it features advanced fluorescent backlighting for vivid VGA graphics. Then, the drives.

Two drives are better than one! First, your notebook will include our whisper quiet high speed, high capacity hard disk. It will read and write your data so fast chances are you'll hardly know it's there. Then we're building in an industry standard 1.44 Megabyte 3.5 inch floppy as well.

From

While most notebooks don't include a floppy drive at all, you're really going to appreciate your ZEOS notebook's industry standard 3.5″ floppy. It makes loading software and transferring files a breeze. Simply toss in your 1.44 and it's done. Anyway, can you imagine a desktop system without a floppy? We couldn't either. That's why your ZEOS notebook has one. It's great!

But the features of your incredible new ZEOS Notebook don't just stop there. Detail after detail we're giving you more than anyone else. Much more, for much less. Take a closer look.

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For instance, the battery system of your new notebook is the most advanced on the market. You can quick charge, or trickle charge, any time your system is plugged in. You can also take the battery out and use the optional charging stand if you wish.

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"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but four times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2
Dazzling Performance.

In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3
Exceptional Quality.

PC Resource Magazine put it this way, "ZEOS . . . provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4
Value.

InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent." *Personal Computing* said, "ZEOS...is the best value we've come across...its performance is right up there with the slickest, most expensive PCs you can buy."

Reason #5
Warranties and Guarantees.

ZEOS believes in its products. That's why we offer each and every customer our 30 Day Absolute Satisfaction Money Back Guarantee, no questions asked. Plus, our One Full Year Limited Warranty and Express Parts Replacement Policy. Optional On Site Service is available too. Call for details.

Reason #6
24 Hour Toll Free Technical and Sales Support.

At ZEOS, the customer is #1. That's why we invented 24 Hour a Day Tech Support. For *your* convenience. If you buy a product from us we feel we should be there to help, any time of the day or night. Give us a call Toll Free! 800-423-5891. Anytime!

Reason #7
Experience.

Almost unique in the mail order computer industry, ZEOS maintains its own chip level Research and Development staff. In addition to Systems Manufacturing, we also operate our own Board Level Manufacturing facility.

ZEOS has been involved in Research and Development since our incorporation back in 1981. Our strong and experienced Research, Manufacturing and Technical Staff translates into superior factory direct computer systems for you.

Reason #8
A Sterling Reputation.

In magazine after magazine and review after review ZEOS systems are cited for Overall Excellence, for Excellent Value, as the Right Choice and so on. All of this is flattering but the most important thing is this: What do our customers think? Frankly, they love us. The systems and the support. That means more to us than anything.

Reason #9
Easy to Buy.

ZEOS systems are easy to buy. You can pick up the phone any time of the day or night and order your new ZEOS computer. And we accept MasterCard, Visa, American Express, and Corporate Purchase Orders from Fortune 1000 Companies, Colleges, Universities and Governments. Complete Leasing Programs are available as well.

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Reason #10
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☐ **INDIVIDUAL CREDIT** but rely on income or assets of another person as a basis for repaying the credit requested. Complete entire application.

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CIRCLE 723 ON READER SERVICE CARD

FACT FILE

Tangent Model 320L
Tangent Computer Inc., 197 Airport Blvd., Burlingame, CA 94010; 800-223-6677, 415-342-9388.
List Price: With 1MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA display, one parallel and two serial ports, DOS 4.01, $2,725.
Options: 1MB RAM upgrade, $165; 4MB RAM upgrade, $495; upgrade to 100MB hard disk, $295; 2,400-bps modem, $175; numeric keypad, $24; external floppy disk drive, $245; extra battery pack, $105.
In Short: Essentially identical to the Fora LP386SX Model 70/20, the Tangent Model 320L offers the same 20-MHz 386SX performance, a highly readable screen, and an excellent keyboard. Yet Tangent's price is low enough to make this by far the more interesting system.

CIRCLE 618 ON READER SERVICE CARD

70/20, the Tangent Model 320L's keyboard and screen are probably its best points. The keyboard has a similar feel to those of the popular Toshiba portables. And the backlit LCD screen is extremely readable, though certainly not the best you can find.

Overall, its combination of size, weight, and short battery life make the 320L, like the Fora 70/20, a decidedly average system. Unlike the Fora entry, however, the 320L sells for a better-than-average price—about $1,000 less than the Dell 320LT, for example. And that makes it more interesting. Consider this one, if you are looking for a luggable laptop and are willing to settle for an acceptable screen.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T3100SX

by Fredric Burke

After winning two consecutive Editors' Choice awards (*PC Magazine*, March 13 and October 16, 1990), the Toshiba T3100SX has become the standard by which other laptops in its class are judged. Although newer, less-expensive 80386SX-based laptops may turn in better benchmark test scores, they do not diminish the T3100SX's strengths. If anything, the T3100SX's staying power underscores the lead that the machine has enjoyed from the start.

Priced at $5,699, our evaluation unit came with 1MB of RAM, a 40MB JVC hard disk, a 1.44MB floppy disk drive, a VGA gas-plasma display, one serial and two parallel ports, and DOS 4.01. With an 80MB hard disk, the price jumps to $5,999. On paper, these specs are no different from those of a lot of machines. In their implementation, they add up to a machine that merits distinction.

Inside the handsome and rugged 14.9-pound clamshell-type machine is a Toshiba motherboard with an 80386SX chip rated at 16 MHz, switchable to 8 MHz. Toshiba manufactures the chip set and the 8- to 10-MHz bus; the BIOS, shadowable in both system and video modes, is licensed from Award.

The Toshiba does not allow for internal expansion, save one proprietary slot. Users who cannot live without expansion

Toshiba T3100SX, $5,699.

slots can purchase the $1,499 Deskstation 3 expansion chassis, which features one 8-bit and two 16-bit slots, and one parallel and two serial ports.

The T3100SX offers generous room for RAM; while the tested system came with only a stingy 1MB of 80-nanosecond RAM, the motherboard will support up to 13MB in 2MB ($999) and 4MB ($2,999) modules. The RAM is nonvolatile: Turn off the machine, and when you come back the Toshiba's AutoResume feature automatically calls your last application back to the screen.

The T3100SX excels in its use of display technology. Like a well-designed theater, there isn't a bad viewing angle in the house. Its VGA gas-plasma screen is crisp, bright, and commendably easy on the battery, and its controls provide for a wide range of adjustment. Should your audience overwhelm the screen, the T3100SX lets you simultaneously use a monochrome VGA monitor with the internal display. The T3100SX's best performance came in video testing; its Paradise video chip set was among the fastest we tested.

The T3100SX's 86-key keyboard also deserves praise. It features large, well-sculpted keys with an action that would embarrass the full-size keyboards supplied with many desktop machines. The keys (including 12 function and 8 cursor) are logically arranged, avoiding the quirky arrangements that other manufacturers force users to accept. The only element missing from the keyboard is a separate keypad; an external keypad is available for $99.

You may be concerned about Toshiba's battery life, which, unaided by power-conservation techniques, pales compared with other 386SX notebooks. Toshiba beats the competition, however, by providing an outstanding array of user-configured power-down features. The company says these features help bring the battery life to 3 hours. The display shuts down first, followed in short order by the hard disk and, finally, the CPU, if the unit has been idle long enough. In that event, work is stored in nonvolatile RAM. If you ignore the various beeps and lights that warn you that the battery is running out, or if you don't call up the pop-up graph of battery life, your work will be stored for up to 8 hours while the batteries recharge.

Despite the fact that faster and less expensive machines are starting to make the T3100SX look a bit old, this laptop remains a landmark in its class, with a plethora of power-saving devices and arguably one of the finest screens available. The smart money stays here.

FACT FILE
EDITORS' CHOICE

Toshiba T3100SX
Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92713; 714-583-3000.
List Price: With 1MB RAM, 40MB hard disk, one 1.44MB floppy disk drive, gas plasma VGA screen, one parallel and two serial ports, DOS 4.01, *Windows* 3.0, $5,699.
Options: 2MB RAM upgrade, $999; 4MB RAM upgrade, $2,999; upgrade to 80MB hard disk, $300; 2,400-bps modem, $299; extra battery, $129; AC adapter, $129; Deskstation 3 expansion chassis, $1,499; numeric keypad, $99.
In Short: Age has not diminished the appeal of the T3100SX; its superior combination of screen legibility and battery life still keeps it ahead of the competition.

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CIRCLE 182 ON READER SERVICE CARD

LOGITECH

Tools That Power The Desktop.

TWINHEAD CORP.

Twinhead SuperLap 386SX/20

by Bill O'Brien

Twinhead's SuperLap 386SX/20 is one of nine battery-powered 20-MHz 80386SX-based laptops reviewed in this roundup. In terms of price, its closest competitor is the Tangent Model 320L, which at $2,890 is the lowest-priced 20-MHz of the group and undersells the SuperLap 386SX by about $200.

The SuperLap 386SX we tested came with 2MB of 80-nanosecond RAM (expandable to 4MB), a 40MB Conner IDE hard disk, a 1.44MB internal floppy disk drive, a VGA display, DOS 4.01, and a soft carrying case. The $3,070 price tag for this configuration makes this system look all the more attractive.

The SuperLap 386SX/20 gets its smarts from a Twinhead motherboard and a Phoenix BIOS; the former has a socket for an 80387SX math coprocessor, and the latter supports both video and system BIOS shadowing. A Cirrus video chip set drives the cold cathode fluorescent tube (CCFT) display. At first glance the quality of the display appeared to be merely adequate; full-screen text and graphics had a tendency to overdrive the backlit paper-white CCFT screen. A call to Twinhead's technical support staff revealed that the machine's VGA system is actually Super VGA–compatible, and that a variety of included utilities and drivers can be used to customize the display characteristics of the internal display or an external monitor.

Twinhead SuperLap 386SX/20, $3,070.

Setting the driver's parameters to adjust the screen's contrast and brightness was a one-time operation that quelled our complaints and improved the quality of the display. Whether this procedure adds value or just adds work depends on how you're going to use the machine.

Pop open the lid of the 12.3-pound Twinhead SuperLap and the keyboard detaches, giving you about 18 inches of stretching room. The back panel of the machine is home for one parallel and two serial ports, separate ports for the external floppy disk drive and for an expansion box that includes a floppy disk drive and a 16-bit expansion slot, and an external VGA port. With an optional modem card ($195) installed, phone jacks also come out through the rear of the system.

The power switch is located on the right side of the machine. It's the press-and-hold type, which is annoying until you realize that you'll never accidentally turn the portable on because of it. Adjacent to the power switch you'll find the external keyboard connector. You can attach a numeric keypad to the SuperLap through one its COM ports rather than through a dedicated connector.

The Twinhead's battery is rated to last 3 hours. On our Battery Rundown test, it provided just over 2 hours of computing time. To conserve power, the machine provides display and disk power-down features. According to Twinhead, it takes 2 hours to recharge the battery, whether the system is on or off.

The 83-key Twinhead keyboard uses full-size keys and conventional spacing. Several do double duty as numeric keypad keys. Twelve function keys, the cursor arrow cluster, and the editing keys are all single-function keys.

The main manual is on a par with some of the best in the industry. Rather than being a haphazard collection of information, it's typeset on slick paper, spiral bound, and heavily illustrated. But it can also add about a pound of weight to your load. For your convenience, Twinhead includes a portable manual that measures only 6 by 3.5 inches, weighs about 4 ounces, and has about two-thirds of the information that the standard manual contains. The portable manual leaves out all of the one-time customizing information, but otherwise it is the main manual's diminutive twin.

FACT FILE

Twinhead SuperLap 386SX/20
Twinhead Corp., 1537 Centre Point Dr., Milpitas, CA 95035; 800-545-8946, 408-945-0808.
List Price: With 1MB RAM, 40MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 4.01, carrying case, $2,995.
Options: 1MB RAM upgrade, $75; upgrade to 120MB hard disk, $395; 2,400-bps modem with MNP 5 error correction, $195; extra battery, $99; recharger, $49; expansion chassis, $429; numeric keypad, $99; external floppy disk drive, $249
In Short: One of the lowest-priced 20-MHz portables, the Twinhead SuperLap 386SX/20 comes with enough added extras to make it a strong choice among laptops.

CIRCLE 620 ON READER SERVICE CARD

With roughly average performance on PC Magazine Labs' benchmark tests, a low price, and a one-year warranty covering parts and labor, the Twinhead SuperLap 386SX/20 is an attractive buy. Once you own a SuperLap, you may never go on the road without it.

DATAWORLD INC.

Dataworld Data LP/320 Dataworld Data LP/325

by Fredric Burke

Dataworld's standard-bearers in this roundup, the Data LP/320 and the Data LP/325, are two machines whose low prices are unfortunately mitigated by bulky packaging, poor video, and (for the LP/320) surprisingly low performance.

The only differences between the two machines are their clock speeds, prices, and distribution channels. The $2,800 LP/320, a 20-MHz 386, came to PC Magazine Labs with 2MB RAM, a 43MB Conner hard disk, a 1.44MB floppy disk drive, one parallel and two serial ports, a VGA LCD, DOS 4.01, and *FastLynx*, a data-transfer software package. This system is available directly from Dataworld.

The 25-MHz LP/325, available from dealers and configured with the exact same components, costs $3,655. If you take into consideration a typical dealer discount of 30 percent, however, the 25-MHz model is a far better bargain.

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CIRCLE 343 ON READER SERVICE CARD

LOGiTECH

Tools That Power The Desktop.

compatibles and Macintosh systems.

Dataworld Data LP/320, $3,075.

Each computer weighs 19 pounds. We accepted this system because it has 386DX power, though we still believe it's impractical by today's standards for use as a portable. Dataworld says it manufactures its own motherboards, and the expansion buses for both run at 8 MHz for the single ISA 8-bit slot each features. Chips and Technologies provides the chip set, and Phoenix manufactures the BIOS. Neither machine features a processor RAM cache, and both will support an 80387 coprocessor, but not a Weitek coprocessor. System RAM for the two machines is limited to 8MB of 1MB SIMMs; an upgrade to 8MB costs $425.

On PC Magazine Labs' 80386 Instruction Mix test, the LP/325 turned in the fastest numbers—which is not surprising, since this system has the most powerful processor of any in this review. The LP/320, however, showed notably worse results; several 386SX/20s turned in better scores.

Another weak point is these machines' display systems. The backlit, double supertwist LCD VGA screen is fairly resistant to washing out in direct light, but the corners of the screen fade, and the brightness and contrast controls are not up to the task. Neither system supports simultaneous external displays, though an external VGA monitor can be hooked up to both.

Battery life hovers around 2 hours—about average for this type of system. Power-saving utilities are limited to user-configurable screen-blanking and disk power-down times, plus a low-battery LED warning. The unit does not save the contents of memory when the battery dies, so users who are warned must move fast to store their data or move to AC power. Recharging the battery takes 8 hours with the machine on or 6 hours with it off.

Dataworld Data LP/325, $4,080.

The Cherry keyboard's keys are logically arranged, with no compromises for the sake of function. In practice, the fixed keyboard position was comfortable, though the angle of the top keys seemed too flat for immediate orientation.

The LP/320 and LP/325 have several options available. Hard disk upgrades include two Conner IDE units, a 104MB for $265 and a 209MB for $590.

All in all, the Dataworld LP/320 and LP/325 are disappointments. Despite their processing power, relatively low prices, and the solidity of their construction, their video is inadequate and they weigh too much. These machines would find favor only with users who don't mind carrying such a heavy load and desperately need 25-MHz 386 power from a battery-operated unit. If your needs exceed these limitations, look elsewhere.

FACT FILE

Dataworld Data LP/320
Dataworld Inc., 3733 San Gabriel River Pkwy., Pico Rivera, CA 90660; 213-547-4196.
List Price: With 1MB RAM, 1.44MB floppy disk drive, 43MB hard disk, VGA LCD screen, EMS driver, *FastLynx*, DOS 4.01, $2,725.
Options: 1MB RAM upgrade, $75; 7MB [[8MB?]]CE20RAM upgrade, $425; upgrade to 104MB hard disk, $265; 2,400-bps modem with send-fax capability, $110; AC adapter, $65; external floppy disk drive, $110.
In Short: The 19-pound Data LP/320's weaknesses far outweigh any residual strengths, most notably the system's low prices, robust construction, and ability to run a full 80386 processor on batteries. Poor hardware performance makes this a tough recommendation.

CIRCLE 621 ON READER SERVICE CARD

FACT FILE

Dataworld Data LP/325
Dataworld Inc., 3733 San Gabriel River Pkwy., Pico Rivera, CA 90660; 213-547-4196.
List Price: With 1MB RAM, 1.44MB floppy disk drive, 43MB hard disk, VGA LCD screen, two parallel and one serial port, EMS driver, *FastLynx*, DOS 4.01, $3,580.
Options: See above.
In Short: The only battery-powered 386/25 in this roundup, the Data LP/325 fares somewhat better than the LP/320 but still suffers from poor video scores and overall bulk. With dealer discounts, the LP/325 is a better bargain than the LP/320.

CIRCLE 622 ON READER SERVICE CARD

VERIDATA RESEARCH INC.

Lappower 386-20

by Fredric Burke

The proliferation of small companies in the laptop market is nowhere better exemplified than by Veridata Research's Lappower 386-20. At $4,500 for the version we tested, including 2MB of RAM, a 40MB Conner hard disk, a 1.44MB floppy disk drive, VGA, and DR-DOS, the Lappower 386-20 was among the more expensive machines tested, though it was also among the more capable. The Lappower further distances itself from many of its peers in that the company manufactures many of its own components, most notably the motherboard, expansion chassis, and video controller.

The Lappower's motherboard is switchable between 8 and 20 MHz. Headland Technology manufactures the chip set, while Award provides the BIOS, shadowable in both system and video modes. There is no provision on the motherboard for a RAM cache, but the Lappower is still faster than any battery-powered 386SX in this review. Its performance falls between that of the IBM PS/2 Model P70 and the Toshiba T5200, both AC-powered 386/20 portables.

Veridata places its system RAM on a card mounted on the motherboard; 2MB came with the tested version, and you can boost that to 16MB using 1MB and 4MB chips. A 4MB RAM upgrade costs $450; 8MB is available for $855.

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CIRCLE 162 ON READER SERVICE CARD

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What's more, both the 433TE and the 425TE have the Dell designed SmartVu™ diagnostic display built in. This ingenious innovation helps identify problems even if the monitor goes down.

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The Lappower's backlit VGA LCD supertwist screen is a good example of the breed, though the controls could afford more adjustability. Text and graphics are sharp, and the screen resists washing out and blooming, although screen updates seem to take an eternity. The Lappower fared only so-so in video performance testing, but that can be traced to the machine's components. Veridata further hamstrings the performance of the machine by not allowing it to support a simultaneous external display, though there is an external port for a VGA monitor.

Trim and compact compared with transportable 386DX machines, the 14-pound, 4.3- by 13.7- by 8.5-inch Lappower is a tidy package. Its battery is rated for 2 hours of constant use; conscientious application of power-down features to its 63-watt power supply stretch that time. The screen will blank first (the user sets the intervals for all but the system power-down), followed by the hard disk and peripherals. To warn unwary users that battery life is dwindling, there are both audio and LED warnings at 30-second intervals; the interval shortens to 15 seconds just before the batteries finally give out.

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The Lappower's backlit VGA LCD supertwist screen is a good example of the breed, though the controls could afford more adjustability.

Options for the Lappower include a $299 internal modem that fits a dedicated

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slot and an expansion chassis that allows the user to use the Lappower as a desktop machine. For anything other than the most casual use the expansion chassis is essential; internally the Lappower is not expandable. The chassis, at $999, comes with a 1.2MB floppy disk drive, one parallel and one serial port, and one 8-bit and two 16-bit slots.

That Veridata Research manufactures its own components for the Lappower is a good indicator of its commitment to the machine.

The Veridata Lappower 386-20 is a dark horse in the portable 386 race. While its Direct to Screen speed and lack of adjustability are its weakest points, they are not that much of an issue. That Veridata manufactures its own components is a good indicator of Veridata's commitment to the machine. Consider the twin virtues of relative lightness and ruggedness, and the Lappower is a sensible choice. ■

FACT FILE

Lappower 386-20
Veridata Research Inc., Arcadia, CA 91006; 818-303-0613.
List Price: With 2MB RAM, 40MB hard disk, one 1.44MB floppy disk drive, VGA LCD screen, DR-DOS 3.41, $4,500.
Options: 4MB RAM upgrade, $450; 8MB RAM upgrade, $855; upgrade to 120MB hard disk, $600; 2,400-bps modem, $299; extra battery pack, $129; numeric keypad, $129; expansion chassis, $999; carrying case, $79.
In Short: The Veridata's aggregate strengths easily outweigh relatively slow video performance. The only 386/20 in our roundup, this system gives a decent performance boost over 386SXs while retaining a 14-pound package. For extra power, the system seems a sound choice.

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AC-Powered 386s

When you need the mass storage or want the color capability you can't yet find in a battery-powered laptop, consider one of these five AC-only 386s.

PHOTOGRAPHY: JOHN WILKES

by Fredric Burke

No mobile computer user who requires a 100MB or greater hard disk drive, a fast gas-plasma or color display, and the 25- or 33-MHz computing speed of the 80386DX processor can accept the tradeoffs currently inherent in a battery-powered machine. To date, only an AC-powered portable can match the power, storage, and speed of a deskbound 80386 or 80486-based computer.

Your options are limited, however. When AC-powered 386 portables were reviewed in the December 12, 1989 issue of *PC Magazine* ("20/20 Portable 386s: Over 20 pounds, Over 20 MHz"), executive editor Bill Howard lauded the step they represented in terms of on-the-road power but concluded that their "fit and finish were below the standards of their class."

This assessment still holds true in many cases: The worst of these systems come with heavy, full-sized components stuffed into flimsy cases with little or no radio-frequency shielding; they also lack FCC Class B certification, mandatory for all portable PCs.

PC Magazine is making an ongoing effort to weed these systems out and present only the ones you can buy legitimately. After all, if you plan to spend a sizable amount of money and lug around a 20-pound 386, you'll want your system to be rugged—or at least legally available.

Although ten vendors sent us a total of 15 machines, we found that only five of these machines had received FCC Class B certification or were being considered for it. Unlike desktop machines, which can carry a Class A rating if they are marketed solely for commercial use, portables cannot be sold in this country without a Class B rating (see "486-Based Portables: Not Yet Ready for the Race" for an explanation of FCC certification). We therefore cut the following machines from this review: Bitwise Model 333/VP, Broadax BSI-V 386-66, Computer Market Place Ultra 386-25L, LANtek Port-O-Lution, Micro Express Regal II/33, Panther 386/25, Panther 386/33, Peregrine 386/33, and Tangent 333p. You may still find these systems for sale, but by strict FCC standards, they are unacceptable.

Also missing from this roundup are systems from Micro Telesis, PC&C Research, U.S. Micro, and Wedge. Though we had originally requested these systems, they failed to meet our deadline for shipment.

The five machines that survived the cuts are established leaders in several categories, for reasons such as mass storage and speed. These five are the Dataworld Portacomp III 386-25, Dolch P.A.C. 386-25C, IBM PS/2 Model 70, Toshiba T5200/100, and the Toshiba T5200C. The Dolch P.A.C. 386-25C, IBM PS/2 Model 70, and Toshiba T5200/100 were designated Editors' Choices in the March 13, 1990 issue of *PC Magazine*.

Besides FCC Class B certification, our list of minimum requirements for machines in this roundup included a 386DX processor, 4MB RAM, 100MB hard disk, and a VGA display. All five of the AC-powered computers that we review in this section were able to meet or exceed these requirements. Toshiba's T5200C and T5200, for instance, both arrived with unsolicited 200MB hard disks.

In this section, we also take a look at the Brick, Ergo Computing's hybrid desktop/portable 386SX (see the sidebar "The Ergo Brick"). Ergo says that it is currently developing a full 386DX version of the Brick.

WORTH THE WEIGHT?

If you're considering a luggable 386, chances are you fall into one of three groups: (1) You work at multiple sites and need a machine for CAD or other power-hungry applications. (2) You plan to use an AC-only unit as a desktop machine, attaching it to a docking station or expansion unit. (3) You'd like to carry your computer from place to place and attach it to a network with an Ethernet or token-ring card. Whatever the reason, you like the flexibility these computers give you.

An AC-only 386 currently offers power users three features that most lightweight battery-powered laptops cannot: full or nearly full-sized motherboards often equipped with standard I/O slots, greater mass storage, and color displays. Along

EDITORS' CHOICE

•Toshiba T5200/100

With few exceptions, the AC-powered 386-based systems that arrived at PC Magazine Labs showed signs of shoddy workmanship and unsuitable bulk. Many also came with illegitimate, sometimes interchangeable FCC identification numbers—if they had any numbers at all. The five systems we did include in this review are all worth your consideration, but the Toshiba T5200/100 portable is the most interesting of the lot.

The ultimate in luggable 386 power comes with a color option, too: the Toshiba T5200C. If you're willing to carry its weight, the T5200/100 is the only AC-powered portable that will give you everything you need. Named an Editors' Choice in the March 13, 1990, issue of *PC Magazine*, it comes with 4MB RAM and a 100MB hard disk in our standard configuration. The monochrome version lists for $8,798; the T5200C, with a 200MB disk, lists for $10,498. If you really need color now, this system has it, but you might want to wait a few months for active matrix color to make its debut.

If Editors' Choices were awarded solely on the basis of speed, the Dolch P.A.C. 386-25C would win hands down. With the help of a 25-MHz 80386 microprocessor and a 32K RAM cache, this 19-pound system turned in some dazzling numbers, outpacing the other systems in this review. The $9,725 price for a system with 4MB RAM and a 100MB hard disk compares favorably with the prices of the IBM and Toshiba systems. Unfortunately, because the Dolch P.A.C. 386-25C still hadn't received FCC Class B status when we tested it, we can't grant the machine an Editors' Choice—though we can give it honorable mention for its performance. At the time we went to press, the Dolch system was fully registered and undergoing technical review at the FCC.

IBM's PS/2 Model P70, with Micro Channel architecture, continues to be a sturdy computer, but its performance on our benchmark tests is slower than even many 386SX/20s we are reviewing in the section on battery-powered portables. If you're thinking about buying an IBM luggable, you'll appreciate its ruggedness and expandability, not to mention the 101-key keyboard, but you'll be disappointed with its speed and the 22-pound weight you have to bear. At $5,995 for a 2MB system with a 30MB hard disk, this system falls at the low end of this roundup's price spectrum.

Dataworld's Portacomp III 386-25 turned out to be the only truly low-priced, Class B–certified 386-25. While we can't name it Editors' Choice, we can commend Dataworld for selling the system as it should, with an external floppy disk drive that provides the proper RF shielding, at a price that we long to see on other Class B 386-25 portables. If you're strapped for cash and need the power, this $3,320 system presents a reasonable choice. ■

with expansion slots, 386DX motherboards generally offer a RAM cache to eliminate wait states and to speed processing. As a further benefit, you'll find that the somewhat larger cases of the AC-only 386s often house 100- and 200MB 3.5-inch hard disks denied to their lighter-weight counterparts. This is an edge that AC-powered 386s are likely to maintain until low-power 2.5-inch hard disk drive technology expands beyond its current 40- to 60MB boundary. Downsized hard disks with more than 40MB of storage space have yet to come to market in quantity. And nickel cadmium batteries lack sufficient power to maintain a system with a color display for more than a half hour or so.

These systems show no major performance differences from desktop models.

Except for Compaq's notebook LTE 386s/20, which comes with 4K of four-way set-associative cached RAM, no battery-operated system in this roundup incorporates a processor RAM cache—a feature once limited to the high-end desktop domain. Similarly, only a small group of desktop 386SXs come with cached motherboards. As more portable systems with 25-MHz and 33-MHz 80386 processors hit the market, processor RAM caches should play a more important role. In this roundup, 32K of fast, static RAM appears in three of the five systems reviewed here. More than half of the systems we chose not to review also came with 16K to 128K of cached processor RAM.

Display technology is a second area in which AC-only machines have a distinct advantage over battery-powered systems. In the coming year, more machines will come to market with color screens. For example, Toshiba plans to migrate color LCD technology to its new, AC-only T3200SXC sometime this spring. But because color screens are still heavier and far more expensive than the alternatives, color LCD does not mean the death of gas plasma or monochrome LCD. In the long run, however, the advent of *thin film transistor* (TFT) technology, also called *active matrix* technology, will make color screens lighter, if not more economical. (For more on the future of color, see the sidebar "Color Portables: Finally Worth Their Price.")

PREMIUM PERFORMANCE, PREMIUM PRICES

You'll still pay a premium for the benefits and performance of a full-fledged 80386-based portable over that of a similarly performing desktop machine. For example, our as-tested version of the Toshiba T5200C, a 20-MHz computer with a built-in color LCD display, costs nearly $10,500. And only about $1,500 of that premium price comes from its color capability. Dolch, too, puts a heavy premium on the combination of color and luggability, charging more than $9,800 for its color P.A.C. 386-25C. Nevertheless, some major manufacturers have lowered their prices from this time last year. Toshiba, for example, has dropped the price of its T3200SX by about $1,500. On the average, you'll pay from $3,000 to $4,500 for a machine like the T3200SX, with exceptions noted above.

Although they are portable, these systems show no major performance differences from desktop models, and their scores on our benchmark tests compare favorably with those of desktop PCs in the same processor class. The Dolch P.A.C. 386-25C, which had the top score in this category, benefitted from a 25-MHz processor and a 32K processor RAM cache. The 20-MHz IBM PS/2 Model P70 computer, with no cache, showed the poorest results, though it did fall within the normal range for comparable 20-MHz desktop systems.

The distinctions between AC-only 386s and their desktop counterparts are becoming increasingly blurred as these portable machines offer power users more options. Though they continue to lack ruggedness and attention to detail, AC-only portables are still the best solution for on-the-road presentations, power CAD use, or plugging into a network. Moreover, upcoming enhancements are expected to soon relieve such current limitations as excess weight, lack of expansion, and few color options. For anyone who depends on a PC to do everything everywhere, no decision should be made without considering one of these capable machines.

DATAWORLD INC.
Portacomp III 386-25

by Alfred Poor

With a list price of $3,320 for our standard configuration, including 4MB of memory and a 100MB hard disk, the Dataworld Portacomp III 386-25 can hold its own against many desktop systems. The fact that this AC-only luggable comes in a lunchbox case adds to its appeal, but before you cart one off, you should consider some drawbacks.

FACT FILE

Portacomp III 386-25
Dataworld Inc., 3733 San Gabriel River Pkwy., Pico Rivera, CA 90660-1404; 800-736-3282.
List Price: 1MB RAM, 40MB hard disk, 1.44MB internal floppy disk drive, 1.2MB external floppy disk drive, VGA gas plasma display, DOS 4.01, *FastLynx*, $2,880.
Options: 1MB RAM upgrade, $75; 3MB RAM upgrade, $175; 7MB RAM upgrade, $425; 11MB RAM upgrade, $775; 15MB RAM upgrade, $1,025; upgrade to 100MB hard disk, $265; upgrade to 200MB hard disk, $390; 80287/10 math coprocessor, $225; 80387/25 math coprocessor, $510; 2,400-bps internal modem with fax-send, $110; 2,400-bps external modem with fax-send, $125; Ethernet card, $169.
In Short: The Dataworld Portacomp III 386-25 offers some interesting extras for less than half the price of some of its better-known competitors. Its low-contrast display and limited expansion potential may be its weakest features, but it should be acceptable for most applications that require a portable PC.

CIRCLE 624 ON READER SERVICE CARD

Like most of the other PCs in its class, the Portacomp III 386-25 is a hefty package to tote; our evaluation unit weighed just a tad more than 20 pounds. The 10- by 15.8- by 8.2-inch package has a convenient carrying handle on top, and the 102-key Chicony keyboard clips on to form the front cover—an advantage over some other designs, since you do not have to unplug the keyboard in order to close the case.

The $2,880 basic configuration comes with 1MB RAM, a 1.44MB 3.5-inch floppy disk drive, and DOS 4.01. A port on the back of the case allows you to attach an external 1.2MB 5.25-inch disk drive, included with every system. Dataworld supplies the external drive to help the Portacomp III comply with FCC Class B standards for radio-frequency emissions.

A hatch on the left side opens to reveal a hardware reset switch and one parallel

AC-POWERED 386-BASED PORTABLE PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Dataworld Portacomp III 386-25	Dolch P.A.C. 386-25C	IBM PS/2 Model P70	Toshiba T5200C	PC Toshiba T5200/100
Price of standard configuration	$3,235	$9,725	$7,695	$10,498	$8,798
Distribution channel	Direct	Dealers	Dealers	Dealers	Dealers
TESTED CONFIGURATION					
Microprocessor	25-MHz 80386	25-MHz 80386	20-MHz 80386	20-MHz 80386	20-MHz 80386
Power supply type	AC	AC	AC	AC	AC
Dimensions (HWD, in inches)	10 x 15.8 x 8.2	9.5 x 16 x 8.3	12 x 18.3 x 5	4.3 x 14.6 x 15.6	3.9 x 14.6 x 15.6
Weight (pounds)	20.8	19	21.8	18.9	18.7
Display subsystem	VGA	VGA	VGA	VGA	VGA
Display area (WxH, in inches)	7.8 x 4.8	9 x 6.9	8.4 x 6.3	8.4 x 6.3	9.1 x 6.8
Display technology	Gas plasma	Gas plasma	Gas plasma	Backlit supertwist LCD color	Gas plasma
Motherboard manufacturer	Dataworld	Dolch	IBM	Toshiba	Toshiba
Chip set manufacturer	C&T	C&T	IBM	Toshiba	Toshiba
Coprocessor installed	None	80387	None	None	None
BIOS version	Phoenix 1.10 22	AMI Revision 2.4	IBM	Toshiba	Toshiba
Date	January 1988	June 1990	May 1989	September 1990	September 1990
Video shadowing/System shadowing	■ / ■	■ / ■	■ / ■	❑ / ❑	■ / ■
MEMORY					
RAM (minimum–maximum)	1MB–16MB	2MB–8MB	4MB–16MB	2MB–14MB	2MB–14MB
Installed RAM	4MB	4MB	4MB	4MB	4MB
RAM packaging	SIP	SIP	SIMM	SIMM	SIMM
Rated speed	80 ns.	80 ns.	80 ns.	85 ns.	85 ns.
Chip size	1Mb	1Mb	1Mb	1Mb, 4Mb	1Mb, 4Mb
Processor RAM cache installed	None	32K	None	32K	32K
Installable options	N/A	32K	N/A	32K	32K
DISK DRIVES					
Hard disk capacity and size	209MB 3.5-inch	200MB 3.5-inch	60MB 3.5-inch	200MB 3.5-inch	100MB 3.5-inch
Manufacturer	Conner	Conner	IBM	Conner	Conner
Interface	IDE	IDE	DBA	RLL	RLL
Average access time	19 ms.	15 ms.	25 ms.	16 ms.	25 ms.
Controller manufacturer	Conner	Conner	IBM	Conner	Conner
Controller location	Card	Motherboard	Motherboard	Drive	Drive
Floppy disk drive capacity	1.2MB, 1.44MB	1.44MB	1.44MB	1.44MB	1.44MB
EXPANSION BUS					
Bus speeds	8 MHz	8, 10, 12.5 MHz	8, 11 MHz	8, 10 MHz	8, 10 MHz
Proprietary expansion slots	1 32-bit	N/A	1 modem, 1 CRT	1 16-bit	1 16-bit
Other expansion slots	2 full-length	8 16-bit	1 full-length, 1 half-length	1 full-length, 1 half-length	1 full-length, 1 half-length
External expansion port	■	❑	■	■	■
Expansion unit	❑	■	❑	■	■
Self-configuring/Single connection	N/A	■ / ■	N/A	■ / ■	■ / ■
VIDEO					
Video modes supported	VGA	VGA, MDA	VGA	VGA	VGA
Gray scales at maximum resolution	16	16	16	16 colors	16
Interface	8-bit	16-bit	16-bit	16-bit	16-bit
Chip set manufacturer	Trident	Ahead	IBM	Paradise	Paradise
Controller manufacturer	Dataworld	Ahead	IBM	Paradise	Paradise
Controller location	Card	Card	Motherboard	Motherboard	Motherboard
Simultaneous external display	■	■	■	■	■
KEYBOARD					
Keys: total, function, cursor	102, 12, 8	86, 12, 8	101, 12, 4	91, 12, 4	91, 12, 4
Keyboard cable length (inches)	36	25	18	N A	N/A
Keypad connector/Keyboard connector	❑ / ■	❑ / ■	❑ / ❑	⌟ / ⌟	⌟ / ❑

PC—Editors' Choice ■—Yes ⌟—No
N/A—Not applicable: The product does not have this feature.

CONTINUES

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CIRCLE 220 ON READER SERVICE CARD

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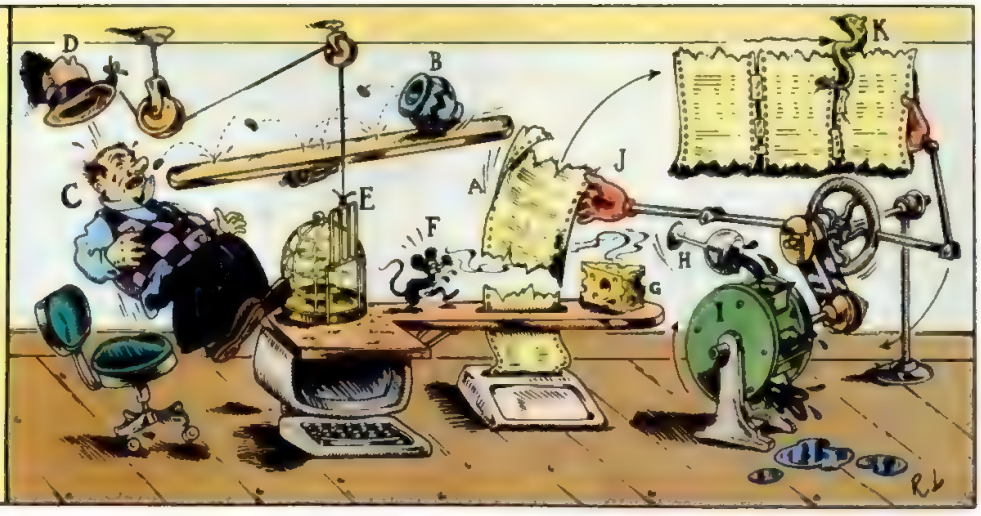
RISING SPREADSHEET (A) KNOCKS MEXICAN JUMPING BEANS (B) INTO MOUTH OF NEUROTIC MAN (C) WHO IS SO DISCOMBOBULATED THAT HIS HAIR STANDS ON END, DISLODGING HAT (D) WHICH OPENS CAGE (E) AND RELEASES EPICUREAN MOUSE (F).

MOUSE, INSPIRED BY SCENT OF PERFECTLY AGED CAMEMBERT CHEESE, GNAWS THROUGH SPREADSHEET, ONLY TO DISCOVER HE HAS BEEN FOOLED BY AROMA OF OVER-RIPE GORGONZOLA (G)

IN A FIT OF PIQUE HE SPILLS VINTAGE WINE (H) INTO WATER-WHEEL (I) WHICH TURNS PULLEY THAT CAUSES GLOVE (J) TO GRASP SPREADSHEET AND MOVE IT TO TAPING AREA.

SHEET IS TAPED SECURELY IN PLACE BY TRAINED ADHESIVE TAPE WORM (K).



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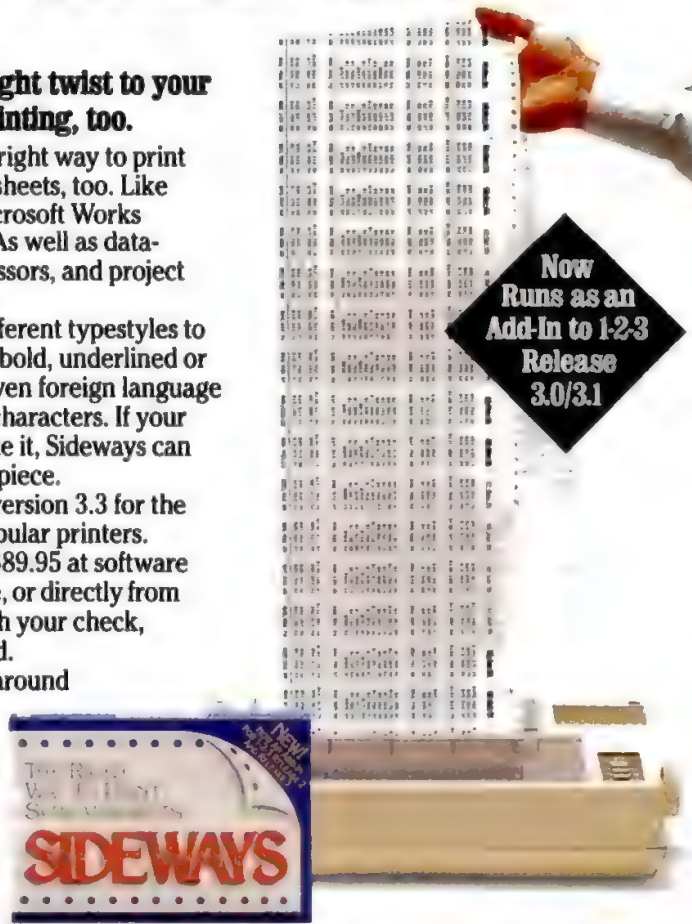

FUNK SOFTWARE

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CIRCLE 323 ON READER SERVICE CARD

AC-POWERED 386-BASED PORTABLE PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Dataworld Portacomp III 386-25	Dolch P.A.C. 386-25C	IBM PS/2 Model P70	Toshiba T5200C	Toshiba T5200/100
SOFTWARE					
DOS	4.01 ($85)	4.01 ($150)	3.3, 4.01 ($150)	4.01	4.01
OS/2	None	None	1.3 ($340)	1.21 ($325)	1.21 ($325)
Disk caching software	None	None	None	None	None
Expanded memory manager	Dataworld	None	None	None	None
Other	*FastLynx*	*QA Plus*	None	None	None
COMMUNICATIONS					
Internal modem	2,400 bps ($110)	2,400 bps ($295)	2,400 bps ($462)	2,400 bps ($299)	2,400 bps ($299)
V.42bis/MNP 5	❑ / ❑	❑ / ❑	❑ / ❑	■ / ■	■ / ■
Modem options	Fax	None	None	None	None
Internal network card	None	None	Token-Ring ($772)	Ethernet ($699)	Ethernet ($699)
PHYSICAL FEATURES					
Power supply (watts)	200	200	90	172	172
Dual voltage	■	■	■	■	■
Power-on/reset switch	Back/side	Back/front	Front/none	Back/none	Back/none
MISCELLANEOUS					
Car battery adapter available	■	❑	❑	❑	❑
Coprocessor supported	80287, 80387	80387	80387	80387	80387
Setup in ROM/Password in ROM	■ / ❑	■ / ❑	■ / ■	❑ / ❑	❑ / ❑
Warranty	1 year	1 year	1 year	1 year	1 year
Service	On-site	Dealer, vendor	Dealer	Dealer	Dealer
FCC certification class	B	B	B	B	B
FCC identification number	GS8TDATA-PE5	I022227X1	ACJ9238573C	CJ6UK836	CJ6UK836

—Editors' Choice ■—Yes ❑—No
N/A—Not applicable: The product does not have this feature.

ENDS

and two serial ports. The machine also includes a VGA port to allow you to hook up an external monitor. The built-in display, a typical VGA gas plasma design, offers little range of adjustment for brightness. The screen's background produces a fair amount of light; you may regret the lack of a control for the contrast.

Dataworld Portacomp III 386-25, $3,320.

Ultimately, this computer suffers from one problem that may affect your decision more than its weight or display. In our standard configuration, only three slots are available, and one of them, intended for memory expansion, does not have its bracket open to the outside of the machine's case.

The memory slot allows you to add a card that effectively doubles RAM capacity to 16MB, but even with connectors on their end brackets, you can add only two more expansion cards. This limitation might be especially troublesome for machines that spend part of their time attached to a network.

Nevertheless, Dataworld supplies a number of useful extras with the Portacomp III 386-25, including a copy of *FastLynx* and documentation that is a cut above the typical mail-order vendor's materials. Dataworld even includes a video that shows users how to get started with a computer.

The Portacomp III 386-25 is offered with some enticing extras. It is by far the lowest-priced Class B solution to your 386DX power needs, but it has fewer capabilities than some of the better-known 386 luggables.

DOLCH COMPUTER SYSTEMS

Dolch P.A.C. 386-25C

by Edward Mendelson

The "C" at the end of Dolch Computer Systems' Dolch P.A.C. 386-25C stands for cache, and the 32K RAM cache that comes standard helps give this compact 22-pound, 25-MHz 80386-based AC-only lunchbox computer its exceptionally impressive performance.

Naturally, all this performance has its cost: In *PC Magazine*'s standard configuration, with 4MB RAM, a 100MB hard disk, a VGA gas plasma display, and DOS 4.01, the price is a hefty $9,725. The machine tested at PC Magazine Labs, with a 200MB hard disk and 80387 coprocessor, costs $11,420.

Even the basic system comes well equipped, with 2MB RAM, a 40MB hard disk, a 1.2MB or 1.44MB floppy disk drive, one parallel and one serial port, a

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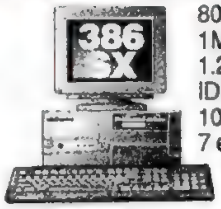

80386SX, 16MHz
1MB, 0 wait state
1.2MB 5¼" Drive
IDE HD controller
101 keyboard
7 expansion slots

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1-year limited warranty

	12" Amber 720x350	14" VGA Color .41 dp 640x480
40MB 28ms	$989	$1219
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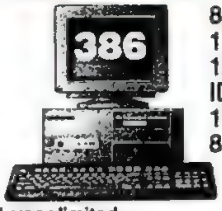
89MB 19ms	$1139	$1369
124MB 19ms	$1229	$1459

Video Card Included! Fully Tested!

COMPUDYNE T386-25C



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1 MB, 32K cache
1.2 MB 5¼" Drive
IDE HD controller
101 keyboard
8 slots, DOS 4.01

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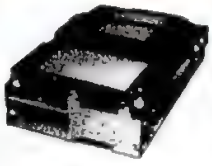
14" 640x480, .39DP $259
LTI 12" mono $69
NEC Multisync 3D VGA $629
Sony 1304 VGA 1024x768 .... $649
LTI 1230A VGA mono $105

Graphics Cards

STB VGA Basic 640 x 480 ..... $65
Compudyne VGA 1024
1024 x 768 ..... $89
ATI BasicVGA 16 ..... $75
ATI VGAWonder 256 Plus $179
Sigma VGALegend $239
Suntek MGP III Mono $25
Leading Tech CGA Color $25

Storage Devices

Seagate 157A Drive



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Seagate ST1144A124MB IDE $569
Seagate ST1239A 211MB IDE $859
Micropolis 1335 71MB ST506 $499

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Toshiba 5¼" 1.2MB $62
Sony 3½" 720K $55
Sony 3½" 1.44MB $62
Pacific Rim 5¼" ext. $199

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Epson LQ2550 ..... $889
Panasonic KX-P1180 ..... $158
Panasonic KX-P1624
24 pin 1326 col $399
Panasonic KX-P4420 laser $789
TI microLaser PS17
PostScript $1479
Seiko Label Printer $169

Joysticks

Kraft KCIII Joystick $14
C&H Flight Stick $39
Quikshot Gamecard $12
Quikshot QS123 ..... $10

Mice

Logitech C9 Serial Mouse $62
Logitech Trackman Serial $75
Logitech Trackman Bus $79
Microsoft Serial Mouse $84

Keyboards

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Chicony 5581 101 w/Trackball .. $69

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101 keyboard
8 slots, DOS 4.01

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	12"VGA White 640x480	14" VGA Color .41dp 640x480	14" VGA color .31dp 800x600
40MB 28ms	$1789	$1949	$1989
89MB 19ms	$1939	$2089	$2139
124MB 19ms	$2029	$2189	$2229
211MB 19ms	$2349	$2509	$2559

Video Card Included! Fully Tested!

COMPUDYNE T486-25C

80486, 25MHz
4MB, 128K cache
1.2 MB 5¼" Drive
IDE HD controller
101 keyboard
8 slots, DOS 4.01

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MADE in the USA

1-year limited warranty

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40MB 28ms	$2689	$2729	$2789
89MB 19ms	$2829	$2879	$2939
124MB 19ms	$2919	$2969	$3029
211MB 19ms	$3249	$3289	$3349

Video Card Included! Fully Tested!

Modems

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2400 baud
Internal modem
Viscom software

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CIRCLE 132 ON READER SERVICE CARD

COLOR PORTABLES: Finally Worth Their Price

Advances in the production of thin-film transistor (TFT) technology have not only made the color portable laptop a viable contender; they may signal the end of the desktop CRT.

by Jim Seymour

The crowds were rarely smaller than three-deep; getting your hands on one of the machines was almost impossible. The pinstriped throngs that jammed Toshiba's booth at last November's Comdex were noisy and pushy and not a bit apologetic for it. When people finally walked away, one word formed on their lips: *Wow!*

Toshiba's new color portables were responsible for the crowds and the enthusiasm. Unlike the incremental improvements of existing PC products on display in other booths, Toshiba was showing something most of us had never seen before: usable, affordable color portables with wonderful displays.

COLOR REVOLUTION PENDING

The words *color* and *portables* rarely appear in the same set of computer specs. Issues of size, weight, power requirements, and image quality have conspired to keep color displays out of the portable-PC market. Price and demand have also played a role, as vendors ask: Do users really want color? Are they willing to pay the price?

Those days aren't over yet—color will continue to be an uncommon and pricey commodity in the portable-PC business for another year or two—but three powerful forces are increasing user demand for color portables. And the vaunted Japanese technology machine is responding with quality, production capacity, and lower prices to meet that demand.

Until recently, the only demands for color on portable systems were from people using carry-around computers for desktop presentations. These on-the-go PC slide shows are very effective for salespeople in many areas. And color can be very important as a selling tool. But that's a small market; even if it grows as rapidly as the desktop-presentation cheerleaders predict, it isn't going to fund a major revolution in display technology.

THE WINDOWS IMPERATIVE

A second force, with a much bigger role in igniting demand for color portables, is the success of *Microsoft Windows* 3.0. For anyone who uses *Windows* on a desktop PC with a color monitor, the look of *Windows* on a monochrome-display portable PC is simply unacceptable.

Because the *Windows* desktop display is incredibly busy, Microsoft made intelligent use of color in *Windows*' various display components—icons, header bars for individual windows, and so on—to make that clutter bearable.

Remove the use of color as a subtle but powerful information tool, and the *Windows* desktop simply becomes muddled. On the relatively low-contrast, murky displays of most portable PCs, *Windows* is a dog.

But get used to *Windows* on your desktop and you're going to want to take it with you. Using *Windows* applications in the office and a different set of character-based applications on the road is a mess, no matter how compatible the file formats of the separate sets of programs may be.

The third trend building demand for color portables is the move among some PC users to abandon desktop machines in favor of portables. At one time, the portable PC was seen by users as an extension of the desktop machine. That view still drives the sales of many of today's notebook PCs. But the nuisances of constantly transferring files back and forth between two machines, keeping track of the latest versions of those files, and the high probability that on any given trip you'll leave at least one critical file on the hard disk in your deskbound machine all get old fast.

Now that portables are becoming as powerful and full-featured as desktop PCs, many users are looking seriously at dumping the desktop box and relying exclusively on the portable. But a portable that bids to become our only PC has to be as capable as a desktop machine. That means a sharp, bright, full-color display.

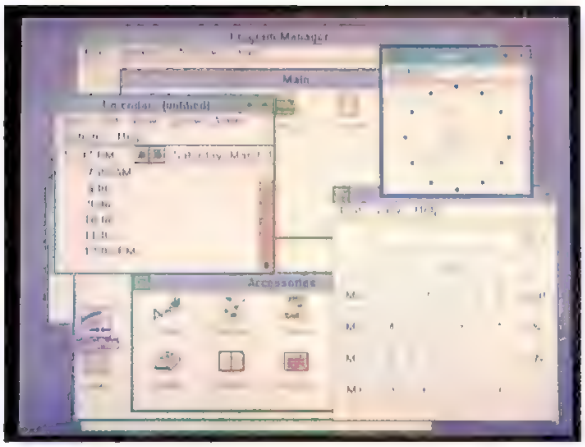
HUMBLE BEGINNINGS

Color portables have had an interesting history. A year and a half ago, NEC was first to jump into the color portable market with a miserable color LCD screen in its ProSpeed CSX. The display was dim, streaky, and ugly, with low saturation, noticeable ghosting, and a narrow viewing angle. It was only about 5 by 8 inches, small for a big, heavy portable. And it offered VGA resolution for text only; graphics were displayed in EGA. You really had to *want* color to put up with that display; at $8,500 and up, the CSX was more a novelty than a business tool, and it did not exactly burn up the market.

Last fall, Dolch Computer Systems introduced a very good Hitachi thin-film transistor (TFT) color display option for its 25-MHz 486 P.A.C. portable. TFT technology is clearly the direction color display panels for PCs are headed. It offers a bright, sharp image with good color saturation and contrast, and a reasonably wide viewing angle. Although the Dolch P.A.C.'s Hitachi display is limited to just eight colors, it otherwise supports the VGA standard. Unfortunately, the heavy, lunchbox-sized Dolch P.A.C. is an expensive machine, with or without the Hitachi display: $11,000 with its standard gas-plasma panel and a whopping $13,500 with the color screen.

THE REAL THING

Then at last fall's Comdex, we got a peek at the real future of color in portable PCs: the Toshiba T5200C. And it's just dazzling.



The passive matrix display of the Toshiba T5200C may not have the snap of standard cathode-ray tube monitors, but it's still useful.

Toshiba introduced its T5200C, a color version of its existing 20-MHz 386DX box. This is yet another large, heavy machine: a 19-pound clamshell. Its supertwist nematic (or STN, sometimes also called passive matrix) display doesn't have quite the snap of a standard cathode-ray tube monitor, but it's good, and very useful.

I've been lugging a preproduction Toshiba T5200C around for some time, and I like it. But I don't make the decision to take it along nearly as casually as I pick up a four-pound notebook PC, like the Sharp 6220/Texas Instruments TravelMate 2000 or CompuAdd Companion units. The T5200C goes along when I know I'm going to spend a trip doing serious computing with *Windows* applications.

Despite its cumbersome size and weight, the T5200C has let me take color on the road. Given the machine's 20-MHz DX power, 200MB hard disk, and big, bright color display, its list price of $9,499 isn't unreasonable.

TFT TO GO

The second color portable Toshiba showed at Fall Comdex was what won viewers' hearts. A smaller, lighter 20-MHz 386SX portable, the T3200SXC will finally unleash the new active-matrix TFT color display that Toshiba has been developing in Japan with IBM. This revolutionary display has been ready for over a year, but production-yield problems have kept it unreleased. Now the IBM/Toshiba joint venture believes it has solved those manufacturing problems sufficiently to bring the unit to market.

It's hard to describe the quality of this display without sounding like a pitchman. It's exceptionally bright and "clean," with lots of contrast and highly saturated colors. Because active-matrix technology uses four dots of color to make up each of the pixels in its 640-by-480 VGA-level display, the brightness of each of those dots can be adjusted to produce a dramatic, photograph-like image. It's not just the equal of a standard television-style cathode-ray-tube display; it's better. You've gotta see it to believe it.

Fair warning: See it and you're going to want it. The T3200SXC runs on AC power only and remains large—about 14 by 15 by 4 inches—and heavy (a full 17 pounds). But even at $8,299 list, there's going to be quite a long line for this one.

That $3,000 premium for superb color is part of Toshiba's two-tiered pricing strategy in color portables. The company believes there are really two markets for color machines: buyers willing to spend up to $1,000 over the cost of a monochrome unit who want decent color, and buyers who will spend $3,000 but demand great color. So Toshiba is offering its first two color units with those price spreads. The T5200C, with its good but not great STN display, costs about $1,000 more than the identical monochrome T5200. And the dazzling T3200SXC costs about $3,000 more than the very similar T3100SX monochrome system.

That same superb TFT display, or one very much like it, will be available soon in a color version of IBM's PS/2 Model 75-486, also shown at Comdex. Only the gas-plasma-display monochrome version Model 75 is available at present; since this 33-MHz 486 screamer costs $15,990 to $18,890 with a monochrome display, expect base-configuration list prices to push $20,000 for the color unit when it becomes available. This behemoth has the same overnight-case design of IBM's earlier Model 70 computer, so don't expect to be able to prop it up on your lap and go to work—even if you could stand its 22-pound weight.

ON THE DESKTOP, TOO?

TFT technology seems certain to edge STN displays offstage before long, although the short-term cost advantages of the STN displays will assure them some share of the market. As the Toshiba-IBM coalition and other TFT producers march down the experience curve, prices for TFT flat-panel color displays will fall sharply, probably approaching CRT display prices in about three years.

In fact, TFT color panels may start displacing desktop CRT displays even sooner. Aside from their elegance and the space-saving rearrangements of our workspaces that ditching "the tube" makes possible, growing concerns about possible dangers from radiation emitted by conventional video display terminals may make the price premium for TFT panels seem less important. The jury is still out on the hazards of CRT radiation, but a definitive study confirming users' fears about VDTs could send sales of TFT color panel displays through the roof. That kind of volume would quickly boost production, pushing prices down even further and faster. ■

CGA double-scan electroluminescent display, and DOS 3.3 or 4.01. That configuration will set you back $8,145. With its 200-watt power supply and four expansion slots, Dolch Computer Systems' P.A.C. 386-25C is essentially a full-scale computer that just happens to have a handle on top.

Dolch's fast machine lets you add up to 8MB of RAM on the motherboard, using SIPs that fit between the expansion slots. Two optional 32-bit expansion cards, with up to 8MB on each $395 card, can also booster your RAM. The computer's expansion is limited to 16MB of RAM.

If the four free slots inside the case aren't enough, a $895 self-configuring Back-PAC expansion unit gives you three more 16-bit slots. And if you're not happy with the gas plasma VGA display (itself a $495 upgrade to the basic CGA system), you can order a built-in $3,995 color VGA display, which wasn't tested by PC Labs. Disk drive options range from 40MB to 200MB in SCSI or IDE formats.

The Dolch P.A.C. 386-25C's construction is solid and efficient. You won't need the manual to open this machine and start working.

The detachable keyboard on the Dolch machine has an excellent feel but a slightly

THE ERGO BRICK

This portable desktop computer lets you take it all with you when you go.

by Henry Fersko-Weiss

The concept is simple: Make a computer small enough to carry around in a briefcase and yet powerful enough to serve as a desktop computer—without the limitations of the typical laptop computer.

This was the mandate that Tom Spalding, president and founder of Ergo Computing, set for himself back in 1985. The result is the Brick, a miniature CPU in a trendy, black-flecked aluminum case.

What led Spalding to build the Brick was the belief that a large group of people who need portable computing actually work at two or three fixed locations. Many people regularly bring work back to a home office, such as the small businessman with two or three branch offices or the executive who travels back and forth between the factory and headquarters. In fact, according to the research Ergo conducted, about 80 percent of the computing that is done by laptop owners occurs at two or three stationary places.

The Brick is one technological solution for people who compute in two or more regular locales. This computer is the size of an average collegiate dictionary—3.3 by 8 by 11.3 inches—and weighs only 11.2 pounds, including its external AC power supply. This makes the Brick easy enough to carry around in a briefcase or in its own canvas carrying case. According to PC Magazine Labs' benchmark tests, the Brick is as fast and powerful as other top-notch 16- or 20-MHz 386SX desktop computers. So by simply keeping a full-size keyboard and

Ergo Brick, $2,695

high-resolution VGA monitor at each location, you'll have a true portable desktop computer. The beauty of this arrangement is that you never have to worry about the consistency of your data files. You don't have to keep updating programs in your computer at the office and at home; you just take it all with you.

You also never have to compromise on the comfort of using a fully configured PC with a normal keyboard and 14-inch color screen. And if you do need to compute in transit, on a plane or train, or in someone else's office, Ergo has a midsize 101-key keyboard and will soon offer a supertwist LCD panel that plugs right into the back of the computer.

Even better, this flexibility doesn't cost a lot: just $3,589 for a 20-MHz system with 4MB of RAM, a 100MB hard disk, one 1.44MB floppy disk drive, a 1,024- by 768-pixel Relysis monitor, and a built-in 2,400-bit-per-second Hayes-compatible modem. This price also includes a wide array of software: DOS 3.3 or 4.01; *Microsoft Windows* 3.0, *DESQview* 2.26, *QEMM-386* 5.1, or either the *Manifest* or the *Cache86* disk-caching programs; *Tree86* (a file manager); *Fastlock* (an encryption utility); and an on-line hypertext help utility for the Brick and DOS. The basic configuration—a 16-MHz model with 2MB of RAM, a 44MB hard disk, and a monochrome VGA display—costs $2,695. Go to the maximum of 8MB of on-board RAM and a 200MB hard disk and you'll pay $4,587.

Inside the Brick are two processor boards. The CPU board holds the 80386SX chip, the optional $395 80387 coprocessor, and the rest of Chips and Technologies' low-power LEAP chip set. The CPU board also holds the system memory, which is furnished in 1MB SIMM increments rated at 80 or 100 nanoseconds. The 20-MHz model we tested had 4MB of 80-millisecond RAM on the board.

The second processor board, which controls the peripherals, is sandwiched on top of the CPU board. It holds the Chips and Technologies 452 VGA chip, 1MB of video RAM, the IDE hard disk circuitry, a high-density floppy disk drive controller, one parallel and two serial ports, and a 2,400-bit-per-second internal modem.

The Brick's two expansion slots, one 8- and one 16-bit, will accept half-length cards. Unfortunately, the 8-bit slot is

awkward, nonstandard layout. The alpha and cursor keys correspond to the original AT layout, with the Esc key on a combined cursor/number pad. But the 12 function keys are arranged in a line along the top, with no gaps between the three groups of four to help you find the right function key without looking down. If you prefer, you can easily plug in any standard keyboard.

PC Labs didn't test the CGA double-scan display, but the gas plasma VGA, which we did test, is the option you'll want for this class of machine. It may not be absolutely the last word in gas plasma displays, but it's sharp, vivid, and fast. Two feet on the bottom of the case let you tilt the display for a more comfortable viewing angle, yet the screen is clear and bright from any angle.

obstructed by the floppy disk drive, rendering it useless. Ergo claims it will soon sell a $295 docking station that will include a network card slot as well as an extra 16-bit slot. Nevertheless, expansion is the single area in which the size of the Brick restricts your computing power.

Getting inside the computer to reach its extremely compact components is somewhat trickier than with a normal desktop. To start with, the screws that hold the case together are tiny hex-head screws, so you'll need a 5/64-inch allen key—not a tool you are likely to have in your kitchen drawer. Then you have to pry the back panel out, gently, about a quarter of an inch so you can pull it by hand another 4 or 5 inches. This will give you the room to detach a cable connected to a clip on the Brick's top cover.

In spite of the internal squeeze on space, the computer can accommodate a hard disk as large as 202MB. Our test unit sported a 100MB Conner drive with a 25-millisecond access time. On PC Labs' benchmark tests, the hard disk performance was about middle-of-the-road. The processor speed for a 20-MHz machine was also in the middle range. But when it came to the video tests, the Brick did quite well. On all three video tests it was among the top third of the machines tested and only fractions of a second away from the fastest times. These results are important because the VGA controller is designed to support a resolution of 1,024 by 768 with 256 colors—well beyond the range of standard VGA.

The Brick's aluminum case provides an interesting heat-sinking function, drawing the heat from the computer through a flat, liquid-filled plastic bag between the case and the CPU processor board. This heat transfer system means that the computer's fan operates less often, and makes the computer's operation almost silent. The case sports a smart-looking, black-flecked finish with matching keyboard and monitor case, though standard PC beige is also available.

The Brick is an unusual-looking PC based on a unique concept. It may not serve you well if you are constantly on the go and need a computer in many locations. But if you usually do your computing at two or three places and only occasionally need to travel further afield with a PC, then the Brick could be the portable desktop PC for you.

The Brick
Ergo Computing Inc.,
1 Intercontinental Way, Peabody, MA 01960; 800-633-1925, 508-535-7510.
List Price: With 16-MHz 386SX processor, 2MB RAM, 44MB IDE hard disk, 1.2MB 5.25-inch or 1.44MB 3.5-inch floppy disk drive, 1,024 by 768 color display card and monochrome VGA monitor, 2,400-bps modem, Logitech mouse, DOS 4.01, *Microsoft Windows* 3.0, $2,695. **Options:** 20-MHz model with 4MB RAM, 100MB IDE hard disk, 1,024 by 768 color monitor, $3,589.
In Short: The Brick is really a portable CPU the size of a collegiate dictionary weighing about 11 pounds—including the external power supply. It is ideal for easy toting to and from two or three locations where you keep a full-size color VGA monitor and normal size keyboard. It is a true portable desktop computer.

CIRCLE 629 ON READER SERVICE CARD

FACT FILE

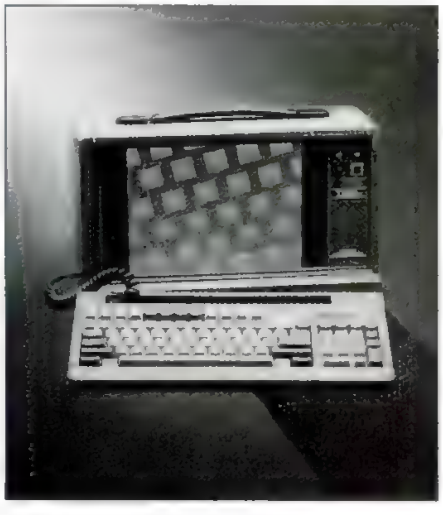
Dolch P.A.C. 386-25C.
Dolch Computer Systems, 372 Turquoise St., Milpitas, CA 95035; 408-957-6575.
List Price: With 2MB RAM, 40MB hard disk, 1.44MB floppy disk drive, CGA electroluminescent liquid crystal display, one parallel and one serial port, DOS 4.01, $8,145.
Options: 1MB upgrade, $195; upgrade to 100MB hard disk, $695; upgrade to 200MB hard disk, $1,495; VGA gas plasma display, $495; 2,400-bps modem, $295; 80387 coprocessor, $895; 20-pound battery pack, $399; carrying case, $95.
In Short: It's hard to imagine a much better lunchbox machine than this one. Its construction and features are top-notch, as is its performance, helped by a 32K RAM cache. The keyboard, while marred slightly by its AT-style layout, has an excellent feel, and the VGA gas plasma display we examined is both vivid and restful.

CIRCLE 625 ON READER SERVICE CARD

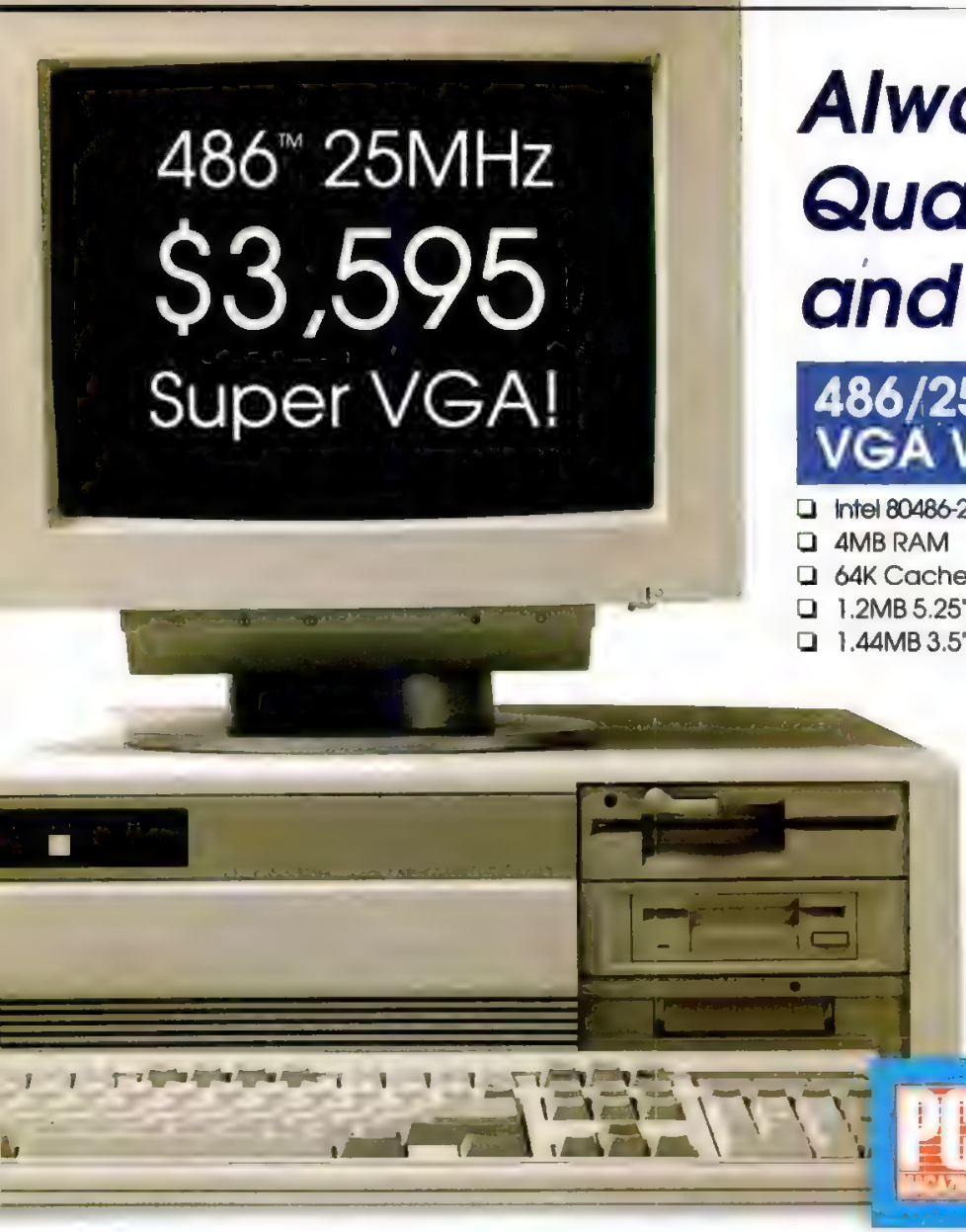
Dolch intends this relative heavyweight to work as an AC-powered machine. The company will sell you a $399 20-pound battery pack that is supposed to be good for about an hour of operation before you need to recharge, but the staff doesn't sound very enthusiastic about it—and neither should you.

Dolch Computer Systems offers a one-year parts-and-labor warranty on its computers. Both the manufacturer and the dealer handle repairs. Dolch also offers on-site service through G.E. Computer Service contracts.

A handsome $95 carrying case with plenty of room for manuals and disks gives the P.A.C. 386-25C all the portability you would expect from a computer in its class.



Dolch P.A.C. 386-25C, $11,420.



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COMPUTER BUYERS GUIDE AND HANDBOOK "The Acma 386SX is highly expandable, performs well, and offers a very complete system for an excellent price...Acma offers one of the best service policies in the mail-order business." "The Acma system not only looks good, it's a good performer...it performed consistently above average." (May/June 1990)

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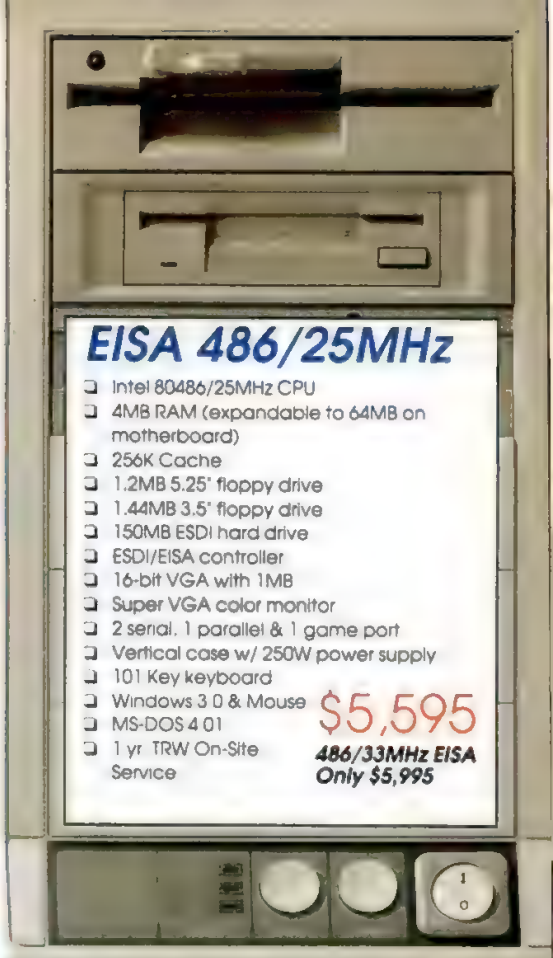

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IBM CORP.

IBM PS/2 Model P70

by Fredric Burke

IBM Corp.'s entry into the 80386-based-portable market is no less attractive than it was last year when first introduced, although signs of age are now beginning to show. The IBM PS/2 Model P70 has considerable memory expansion potential, as well as the advantages of a full-size keyboard and a VGA gas plasma display.

FACT FILE

IBM PS/2 Model P70
IBM Corp., 1133 Westchester Ave., White Plains, NY 10604; 914-642-4662.
List Price: Model 031, with 2MB RAM, 30MB hard disk, 1.44MB floppy disk drive, VGA gas plasma display, and carrying case, $5,995.
Options: 2MB upgrade, $495; upgrade to Model 061, with 4MB RAM, 60MB hard disk, $1,700; upgrade to Model 121, with 4MB RAM, 120MB hard disk, $2,300; 2,400-bps modem, $462; Token-Ring network adapter, $772; keyboard extension cable, $82; nylon carrying case, $180; molded plastic carrying case, $299; leather carrying case, $350.
In Short: The IBM PS/2 Model P70 combines a 20-MHz 386 processor, a full-sized keyboard, and a great display with MCA expansion potential, although it's still the slowest and heaviest system in the lot. Now less expensive than some of its top-name rivals, the Model P70 has become a better value.

CIRCLE 628 ON READER SERVICE CARD

Our $7,695 test version came with 4MB RAM, a 60MB IDE hard disk, a 1.44MB floppy disk drive, a VGA gas plasma display, and a carrying case. A version of the Model P70 with a 120MB hard disk is $8,295—good value for the money.

The Model P70 weighs in at 19.9 pounds, making it slightly easier to lug than other portable lunchbox behemoths. Its relatively compact 12- by 18.3- by 5-inch case stops this computer from eating up too much precious desk space. A quiet 86-watt power supply runs the AC-only machine.

The 20-MHz Model 70's expansion bus consists of one 32-bit MCA slot and one half-length 16-bit MCA slot. A sliding panel on the rear of the machine provides easy access to these slots; in back, users will also find one parallel and one serial port, proprietary external floppy drive ports, and a PS/2 mouse port. Behind the sliding panel, a swinging door permits access to the video connector for an external VGA monitor.

IBM did not include a processor RAM cache in the Model P70, although this feature is gaining favor among its faster competitors as a performance booster. The system will support an 80387 math coprocessor, but not a Weitek coprocessor. A $462 2,400-bps internal modem can be configured for the half-length slot. A Token-Ring network card is also available for $772.

System RAM is generous; there is room for up to 16MB of RAM using 4MB chips, which are costly at $1,095 each. IBM's 80386 Memory Expansion Card, which fits into the 16-bit slot and is required to reach 16MB, is $995 without additional memory.

The Model P70's VGA gas plasma screen is still one of the best on the market; even in bright light, text and graphics are sharp and clear. And while the screen's colors tend to tire users' eyes—a complaint common to owners of computers equipped with gas plasma screens—the screen can be adjusted to fit nearly any viewing situation.

Also deserving of special mention is the Model P70's 102-key detachable keyboard, which is truly full-size, unlike the torture devices marketed by other purveyors of portable computers. Fans of the IBM click will nevertheless be disappointed, because the keyboard abandons tactile excellence for a mushy, clonelike feel. The separate keypad and function keys, all nicely set apart, should make up for that shortcoming.

The IBM PS/2 Model P70 is equally at home on the desktop and on the road. Less expensive than many of its direct competitors such as the Dolch P.A.C. 386-25, the Model P70 now enjoys something of a price advantage—an edge it holds even after the machine has been fully configured. Its power and flexibility have not diminished, though the Model P70 has slipped in comparison to the latest offerings from Toshiba and other competitors. That aside, IBM's Model P70 computer remains one of the premier machines on the market.

IBM PS/2 Model P70, $7,695.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T5200C

by Fredric Burke

Toshiba America Information Systems has ushered in a new era in portable 386 computing with the Toshiba T5200C. The "C" suffix stands for VGA color; so far, Toshiba does the best portable color. With a tested-configuration price of $10,498, the T5200C comes loaded with 4MB of RAM, a 32K RAM cache, a 200MB Conner hard disk, and a 3.5-inch 1.44MB floppy disk drive.

The list price is higher than those of many desktop machines, but it seems justified in the light of the extra disk capacity and the color display.

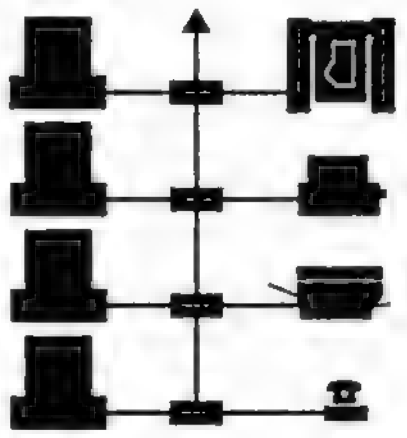
Externally, nothing distinguishes the T5200C from the Toshiba T5200/100. It sports the same handsome crinkle-finish gray, with its various controls and ports logically arranged and easily accessible. And although the machine does weigh almost 19 pounds, it's actually one of the lightest AC luggables available.

Toshiba built the T5200C around the T5200 series, known for their fast and reliable performance. Inside the 4.3- by 14.6- by 15.6-inch case is a Toshiba motherboard whose chip set runs at a steady 20 MHz under directions from a BIOS licensed from Phoenix. Further boosting the T5200C's performance is an Intel single-chip 32K RAM cache rated at 35 nanoseconds. The expansion bus is switchable between 8 and 10 MHz; internal expansion comprises a full-length 16-bit slot and a half-length 8-bit slot, plus a proprietary Toshiba 16-bit slot. The motherboard has a plug for an Intel 80387 math coprocessor, though not for a Weitek 3167 device.

System RAM for the T5200C is expandable to 14MB through a combination

A full-blown server-based network costs a bundle when done right. Add to this the cost of training and ongoing support (sometimes 2 to 3 times the original investment). Undaunted, businesses bite the bullet every day—effectively turning over their entire computer operations to a LAN expert forever. But many, in seeking a less costly alternative, fall into the trap of false economy.

We say "neither is necessary." Why? How?



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Connectivity and networking solutions abound. Traps of all kinds abound also. Unless you're a teflon-coated decision maker (or a job hopper), the solution you choose today should remain appropriate tomorrow. Let's look at where you can go wrong—and right.

First, there are printer sharing boxes—seemingly hundreds of them. They're a fine short-term solution when you have two or three computers that occasionally need access to a single printer. But when applied to more extensive or demanding applications, they become a *bottleneck*, breed unhappy users and managers, and are a *dead-end*... simply put: the "F word" (*False* economy).

Definition of a bottleneck: a printer sharing box—driven by a single microprocessor—receiving print data from several computers, while it is simultaneously supposed to send this data to several printers. Definition of unhappy users: people who have sent their data to said printer sharing box and subsequently lost their data because somebody reset or turned off the box. Definition of unhappy management: said box has died and *nobody* can print. Definition of dead-end (as opposed to dead box): the fact that a printer sharing box has a finite assortment of inputs and outputs. Bottom line: false economy, because printer sharing boxes can impede and frustrate users, and are too quickly outgrown.

If not printer sharing boxes, then there are networks (LANs). They're a hot item nowadays. LAN dealers invite you for a free analysis of your networking "needs". Sure, they'll *help* you—while they help *themselves* to your bank account. Good networks are EXPENSIVE, and require expert support forever! You will always be accountable to the LAN, like a State and Federal sales tax on every change or addition you make related to your computers.

There *are* inexpensive networks available. There are lots of other inexpensive things in this world. But, would you build your business around them? Cheapo networks tend to teach harsh lessons in false economy and, sometimes, false advertising—resulting in NO economy!

You see, some low-cost LANs claim they occupy very little memory (RAM), yet to realistically accomplish what the LAN is supposed to do, they use as much or more RAM as any other LAN. The truth is, all LANs will occupy a substantial amount of RAM. You often find yourself either having to add RAM (if you can)—and memory management software, or dumping some of your other software overboard.

The lesson in false economy comes later, when you buy a multi-user software package and discover it is intended for use on a server-based data-sharing LAN— usually Novell®. Oops. Old LAN overboard!

Want to avoid such harsh lessons? Rule number one: if and when your company has some computer users who need a data-sharing network—so they can simultaneously access a shared database—get the best network money can buy. Buy UPSs, tape backups, the works. Make the commitment. It's a big step, but you'll regret anything less.

It's highly unlikely however that ALL your computer users need or will ever need access to a shared database. Most probably just need to share printers and other peripherals like plotters, modems and fax machines. And perhaps everyone would like to exchange E-Mail and maybe even pass data files between PCs electronically.

Systemizers® are a connectivity solution that will provide these capabilities with none of the traps, drawbacks or excessive costs and commitments previously mentioned. You can apply Systemizers on a global scale, then selectively employ a high-end server-based LAN solution for those users who absolutely need it. *All* users in the company—whether they're on a LAN, WAN, PBX, mainframe, or are independent—can be Systemized™, and they'll benefit from it greatly. In fact, if users are Systemized, the investment required for a data-sharing LAN will be significantly less. Plus, because Systemizers will be handling all print "traffic", the data-sharing LAN will perform better and more reliably.

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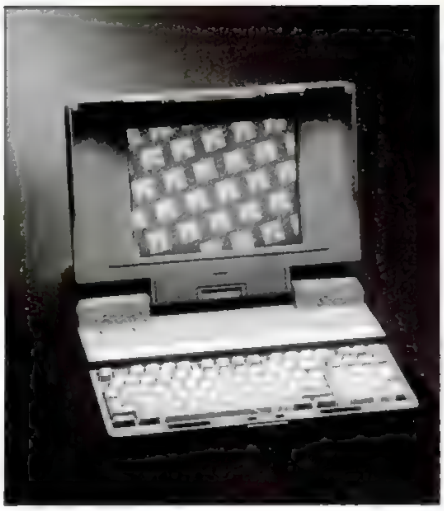


Toshiba T5200C, $10,498.

of 1MB and 4MB SIMMs. RAM upgrades are expensive, with 2MB costing $999 and 8MB an astronomical $3,999. No other memory options are currently available, but 14MB is more than enough for the applications likely to be used on this machine.

Video is perhaps the most important aspect of a laptop. The T5200C's supertwist nematic backlit VGA gas plasma screen is typical of Toshiba laptop screens: It is bright and crystal-clear, readable in nearly every condition and at nearly any angle, and it supports the simultaneous use of a VGA monitor. On-screen colors for the T5200C are as good as the full gray-scale screen. Screen updates via the

FACT FILE

Toshiba T5200C
Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 714-583-3349.
List Price: With 2MB RAM, 32K RAM cache, 200MB hard disk, 1.44MB floppy disk drive, color VGA gas plasma screen, one parallel and two serial ports, DOS 4.01, $9,499.
Options: 2MB RAM upgrade, $999; 8MB RAM upgrade, $3,999; 2,400-bps V.42bis MNP 5 modem, $299; expansion chassis and card, $1,098.
In Short: The Toshiba T5200C's color capability elevates a costly but highly regarded portable. One of the lightest systems in this group (18.9 pounds), this 20-MHz 80386-based T5200C also comes with the largest hard disk (200MB). Toshiba's keyboard design excels, making this system a pleasure to use.

CIRCLE 627 ON READER SERVICE CARD

BENCHMARK TESTS: AC-POWERED 386-BASED PORTABLE PCs

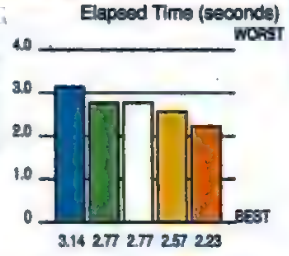
The Dolch P.A.C. placed first among the 25-MHz systems on all of our benchmark tests and, except on the BIOS Disk Seek test, was also faster than the 20-MHz systems. Although its price is high, it is sold through dealers, so you can expect to get a sizable discount for this excellent performer.

For this section we tested five 80386 AC-powered laptops, ranging from 20 MHz to 25 MHz, using PC Magazine Labs' Hardware Performance Tests, Release 5.6. We ran the tests with video and system shadowing enabled wherever possible, and we left the buffers at their default values. We used no software disk caches when performing disk benchmark tests, and no RAM-resident programs were loaded for any tests. The margin of error for the processor, memory, and video benchmark tests is 0.05 seconds, so take this into account when making purchasing decisions based primarily on speed.

PROCESSOR AND MEMORY BENCHMARK TESTS

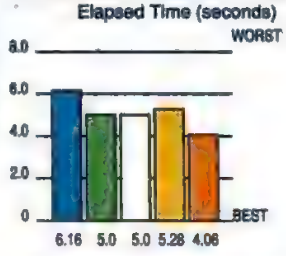
80386 Instruction Mix

The **80386 Instruction Mix** benchmark test times a series of tasks specific to the 80386 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



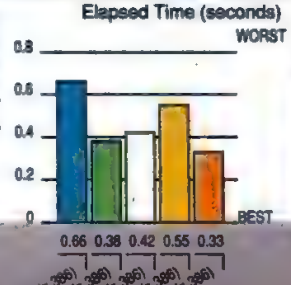
Floating-Point Calculation Without Coprocessor

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



Conventional Memory

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.



Paradise chip set are satisfyingly quick; colors do not wash out or lose their crispness. The controls provide an adequate range of adjustment, and the screen is free of blooming and streaking in graphics mode. In text mode, characters are well formed and easy to read.

The T5200C enjoys the same quality hardware as its siblings, including a handy keyboard layout with well-formed keys and a full set of function keys. The keyboard is better than that found in some desktop systems; its velvety feedback and comfortable position allow hours of painless typing.

Attaching the T5200C to Toshiba's $999 expansion chassis increases the computer's utility. With a $199 expansion card in the proprietary slot on the T5200C's motherboard, the expansion chassis can give users the benefit of five additional 8-bit slots.

The Toshiba T5200C combines the functionality of a laptop machine with the color capabilities of a full-blown desktop system.

The Toshiba T5200C is a landmark computer; it combines the functionality of a laptop machine with the color and hard disk capabilities of a full-blown desktop system.

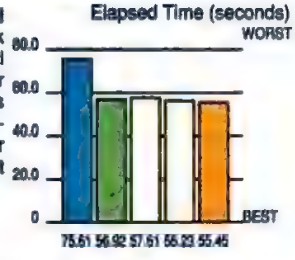
For taking the show on the road, particularly in situations where color is important, the T5200C is one of a kind. The price is steep for a 20-MHz 386 laptop, and upgrades are no less expensive: A fully configured machine can cost upwards of $12,000. But this light, compact, and vastly useful machine should overcome most people's objections.

The Toshiba T5200C should be added to every power user's short list.

DISK BENCHMARK TESTS

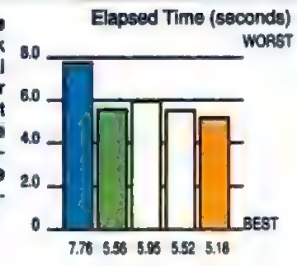
DOS File Access (Small Records)

The DOS File Access (Small Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.



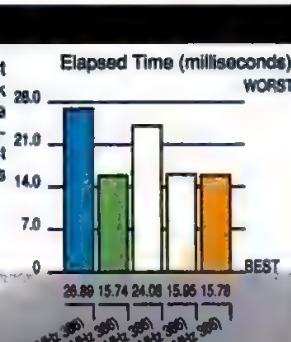
DOS File Access (Large Records)

The DOS File Access (Large Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



BIOS Disk Seek

The BIOS Disk Seek benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

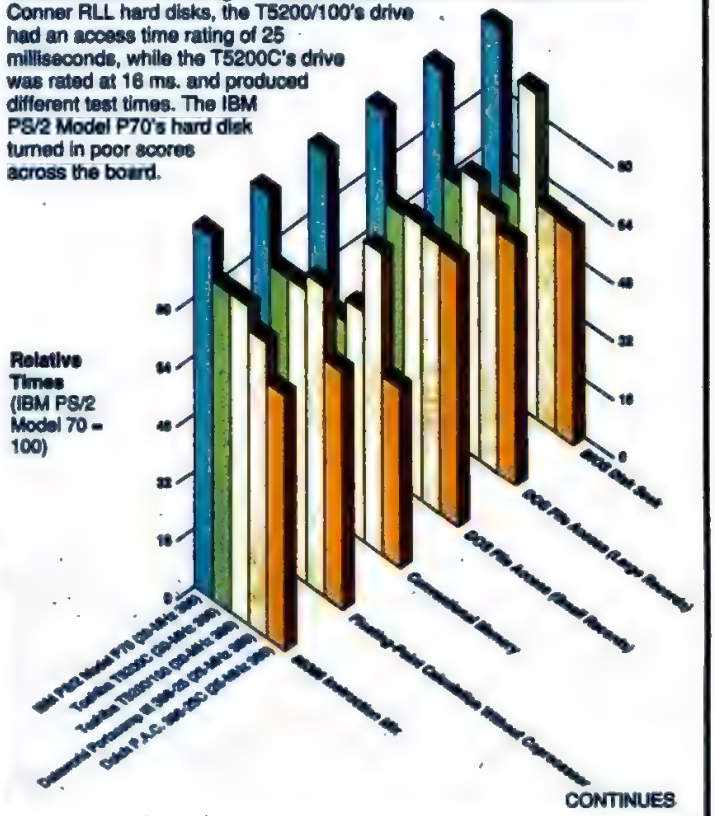


PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

PC LABS

Among 25-MHz systems, the Dolch P.A.C. 386-25C (from a manufacturer known for its high-priced, high-performance systems) turned in excellent times on all three processor and memory tests. Using 32K of processor RAM cache, it bested the Dataworld Portacomp III 386-25, which had no processor RAM cache. The Toshiba systems, which also had 32K of processor RAM cache, similarly outperformed the other 20-MHz system reviewed—the IBM PS/2 Model P70, which, like the Dataworld, had no processor RAM cache.

The Dolch P.A.C.'s 15-ms. Conner IDE drive placed first on all disk tests except the BIOS Disk Seek test, where it came in a shade behind the Toshiba T5200C. Although Toshiba's T5200/100 and T5200C both used Conner RLL hard disks, the T5200/100's drive had an access time rating of 25 milliseconds, while the T5200C's drive was rated at 16 ms. and produced different test times. The IBM PS/2 Model P70's hard disk turned in poor scores across the board.



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TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T5200/100

by Fredric Burke

The T5200/100 may not be the fastest machine around, but Toshiba has put its development money where it counts, as the screen shows.

In the past, taking full-bore 386 computing on the road has presented its own set of problems. Most desktop-level portables are bulky lunchbox luggables whose weight and unwieldiness were considered necessary evils. Toshiba's AC-only T5200/100 shows that there is another, potentially better way. At $8,798 and 18.7 pounds, with 4MB RAM, a 32K RAM cache, a 100MB Conner hard disk, a 1.44MB 3.5-inch floppy disk drive, VGA gas plasma display, one parallel port and two serial ports, and DOS 4.01, the AC-powered T5200/100 is neither lightweight nor inexpensive, but for power-hungry users, its impressive array of strengths should outweigh those concerns. This system, named an Editors' Choice last year (*PC Magazine*, March 13, 1990), retains its appeal, even when pitted against the 25-MHz competition.

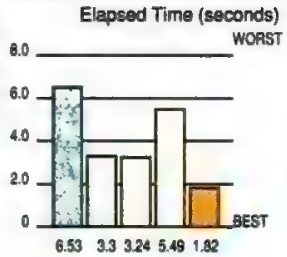
Inside the handsomely styled gray clamshell case is the same Toshiba motherboard found in the T5200C (Toshiba's

PC LABS BENCHMARK TESTS: AC-POWERED 386-BASED PORTABLE PCs

VIDEO BENCHMARK TESTS

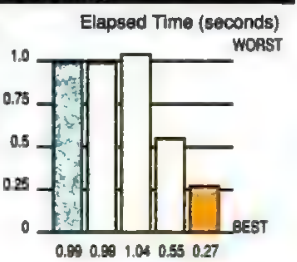
Direct to Screen

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



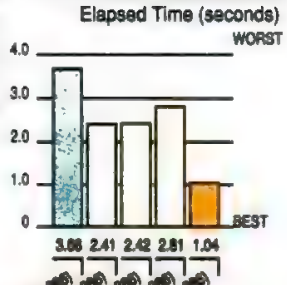
Video BIOS Routine Without Scrolling

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.



Video BIOS Routine with Scrolling

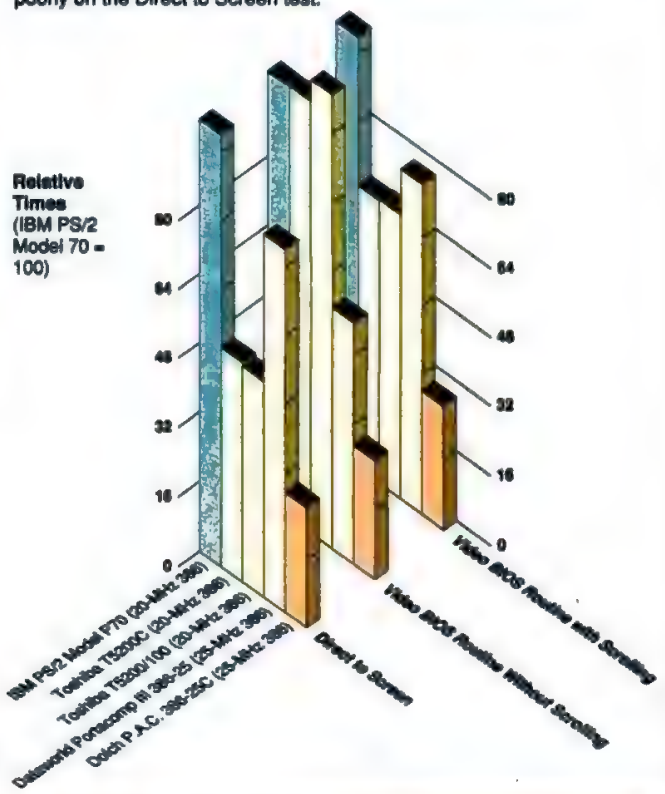
The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



PC LABS VIDEO BENCHMARK TESTS: COMPOSITE VIEW

The Dolch P.A.C. 386-25C, a top performer here as on the other tests, used an Ahead Systems card and chip set. The use of color had little impact on the performance of the Toshiba T5200C and T5200/100 because color does not affect our tests; both machines performed at about the same level. While both had average scores on our Direct to Screen and Video BIOS Routine with Scrolling tests, the Video BIOS Routine Without Scrolling suffered next to other systems.

The IBM PS/2 Model P70 had integrated video (like the Toshibas) but did relatively poorly on all three video tests. The Dataworld Portacomp III's video card with its Trident chip set also performed poorly on the Direct to Screen test.



ENDS

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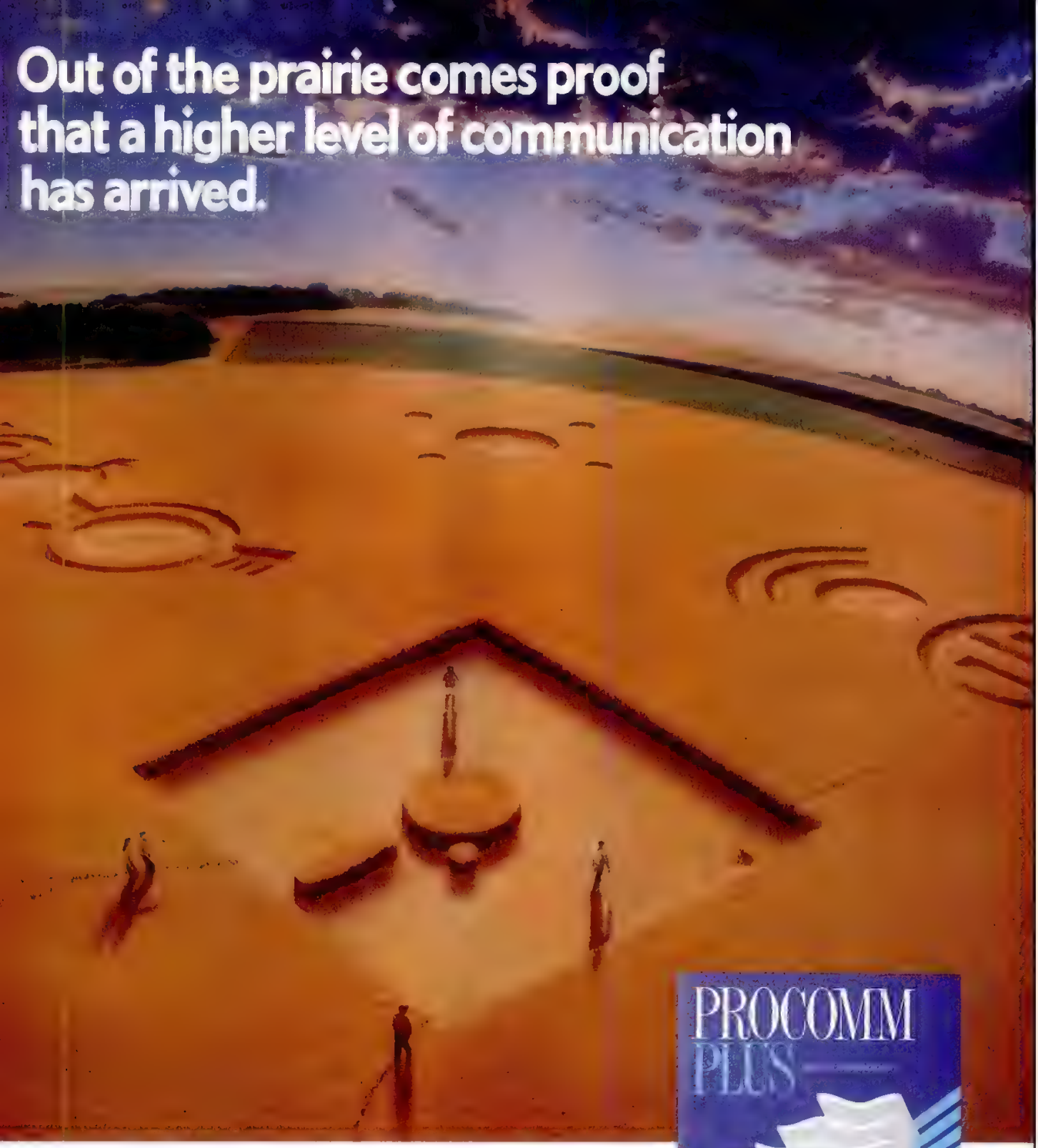

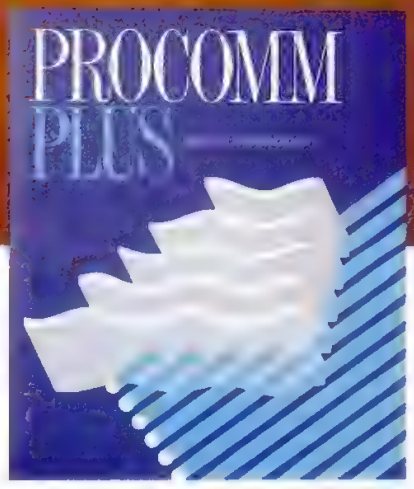

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CIRCLE 361 ON READER SERVICE CARD

color portable), with an 80386 processor and chip set running at 20 MHz. Toshiba licenses the BIOS from Phoenix. The Intel 32-bit bus runs at either 8 or 10 MHz. The motherboard also has an Intel 32K RAM cache rated at 35 nanoseconds; this helped the T5200/100 obtain results on the benchmark tests well above the average. Under the keyboard, users will find a plug for a 20-MHz 80387 Intel math coprocessor. No provision is made for a Weitek 3167 coprocessor—a curious omission in a machine this powerful.

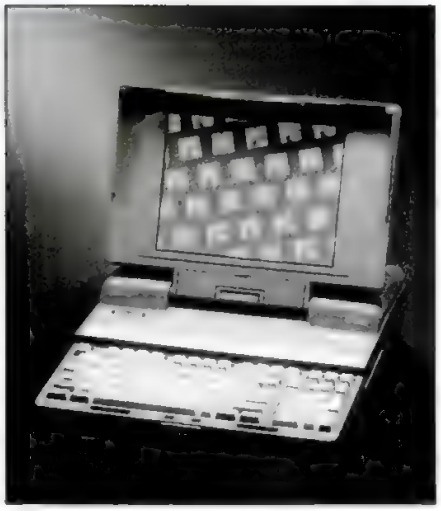
System RAM is expandable to 14MB through a combination of 1MB and 4MB 85-nanosecond DRAM SIMM modules. Adding memory to the Toshiba T5200/100's proprietary memory slots is an expensive proposition: 2MB upgrades cost $999, while an 8MB addition goes for $3,999.

Internal expansion for the T5200/100 comprises a full-length 16-bit slot and a half-length 8-bit slot, as well as a proprietary Toshiba 16-bit slot; if you spring for the $999 optional expansion chassis, you can add five 8-bit slots, plus one parallel and two serial ports.

An external 1.2MB floppy disk drive unit is available for $499. For $299, an internal 2,400-bps modem with both V.42bis data compression and MNP level 5 error correction can be fitted to either the proprietary Toshiba slot or one of the internal slots. Network users can internally add a 16-bit Ethernet LAN card to the T5200/100.

Toshiba T5200/100
Toshiba America Information Systems Inc., 9740 Irvine Blvd., Irvine, CA 92718; 714-583-3349.
List Price: With 2MB RAM, 32K RAM cache, 40MB hard disk, 1.44MB floppy disk drive, VGA gas plasma screen, one parallel and two serial ports, DOS 4.01, $7,199.
Options: 2MB RAM upgrade, $999, 8MB RAM upgrade, $3,999; upgrade to 4MB RAM, 100MB hard disk, $1,599; 2,400-bps V.42bis MNP 5 modem, $299; expansion chassis and card, $1,098; external 1.2MB floppy disk, $499.
In Short: Although it's fairly expensive, the 18.7-pound, 20-MHz Toshiba T5200/100 combines desktop speed and features with the benefit of AC outlet compatibility. As with all Toshiba PCs, the superb keyboard comes standard. An excellent gas plasma screen makes this system ideal for presentations on the road.

CIRCLE 638 ON READER SERVICE CARD



Toshiba T5200/100, $8,798

ACCENT ON DISPLAY

As is typical with Toshiba products, the screen is nothing short of excellent. This backlit VGA gas plasma screen is readable from nearly any angle, bright, clear, and commendably fast. Brightness and contrast controls offer a wide range of adjustments, and the unit has an external port that permits simultaneous external VGA monitor viewing. The orange-and-gray screen does get a bit tiresome; in some low-light conditions a user's eyes may quickly feel fatigued. The Toshiba T5200/100 may not be the fastest machine around—it performed best during video testing—but Toshiba has put its development money where it counts, as the screen shows.

The keyboard for the T5200/100 is as well designed as the rest of the machine, with good feedback and a logical key arrangement, plus a full set of function keys. Although users will quickly discover that the keyboard is not detachable, the keys are placed at an angle that permits comfortable typing.

The Toshiba T5200/100 is one of the finest AC-powered 386 portables around. It is fast and expandable, and it can serve as both a desktop machine (with the optional expansion chassis) and a powerful presentation tool on the road. It is sufficiently flexible that anything short of high-end CAD is within its reach, and accordingly, users will pay for that privilege. Those who cast a skeptical eye at the bottom line when considering the merits of various machines should not look here; the value that T5200/100 represents will be lost on them. ■

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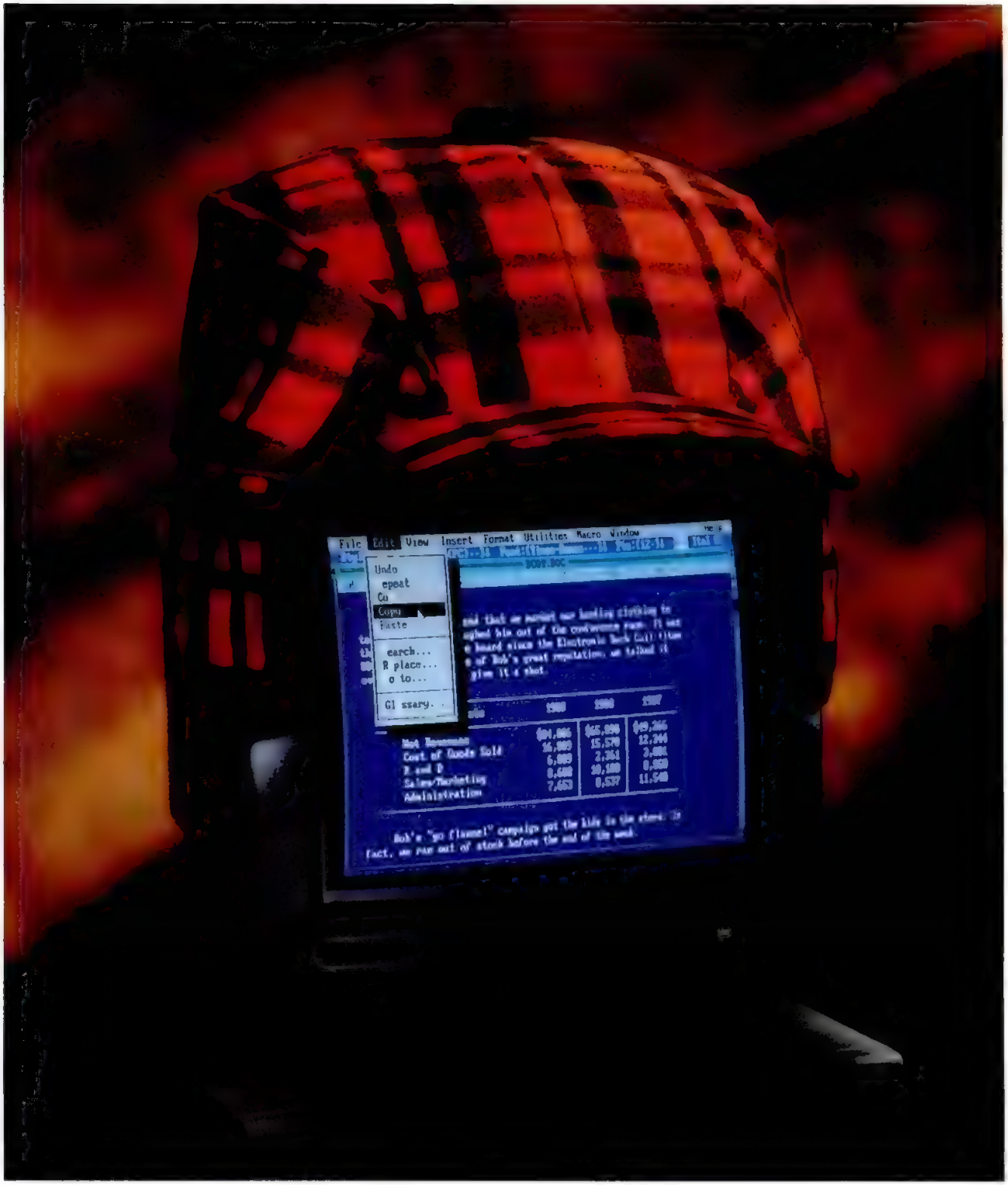
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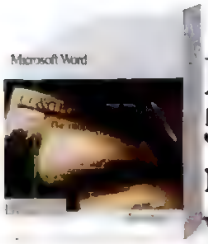

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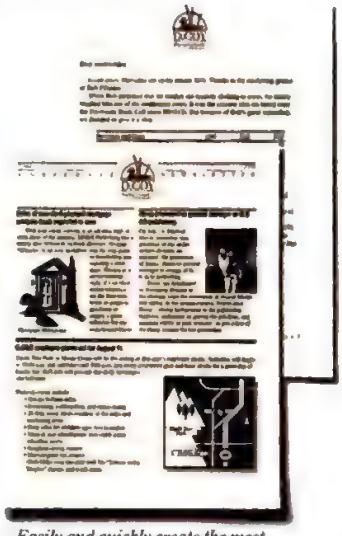

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Requirements for MS-DOS version of CompuServe: Hayes compatible modem and 640K RAM. Hard drive recommended.
*Suggested retail price.

CIRCLE 226 ON READER SERVICE CARD

286 Notebooks

PHOTOGRAPHY JOHN WILKES

At less than 8 pounds each, these 286 notebook computers are made to travel. While you wait for the lightweight 386SXs, these nine notebooks can tackle your on-the-road computing chores without breaking your bank account–or your back.

by Greg Pastrick

One year ago, *PC Magazine* showcased 73 portables (in Volume 9 Issue 5 of March 13, 1990). Of the nine notebook PCs we evaluated then, only two were 80286-based machines—the Compaq LTE/286 and Texas Instruments' TravelMate LT286 Model 12.

The list of 286-based notebooks we review in the current issue includes previously seen technological forerunners like the Compaq LTE/286, the Sharp PC-6220, and Texas Instruments' TravelMate 2000 (which has replaced the LT286). Add to this list the mail-order version of the Sharp PC-6220 and TravelMate 2000 twins—the CompuAdd Companion—plus

the new GRiD 1720, the NEC UltraLite 286V, the Ogivar Internote 286, the Sanyo MBC-17NB, and the Zeos Notebook 286, and the roster tops out at nine machines. Our reviewers discovered that as the list of choices grows, the newcomers come prepared with features, price, and performance to match or beat the early entries.

Clearly, notebook computing is no longer an exercise in the art of compromise.

SXs IN THE WINGS

Indeed, the notebook segment of the laptop market is expanding. International Data Corp. projects that by 1992, battery-powered laptops and notebooks will virtually flip positions in terms of quantities sold, with notebooks then constituting 51.2 percent of the market compared with the battery-powered laptops' 38.6 percent share. IDC predicts that AC-powered-luggable sales will have shrunk to about 10 percent of the market.

Among notebook computer shipments, the 286 chip totally dominated production in 1990. But InfoCorp estimates show 1991 to be a pivotal year, with the 286 and 386SX processor splitting about 95 percent of the market while the 8088 and 80C86 continue to hang on. The projections have the 386SX chip being plugged into nearly 60 percent of the notebooks shipped in 1992 and 1993.

Fall Comdex saw the introduction of a number of 286- and 386SX-based notebook PCs, some of which were not released in time for our review. Among these were the Librex 286 from Nippon Steel, which also announced its 386SX notebook; in addition, there were the Airis VH-286, Osicom 286, Panasonic CF-270, and Tandy HD-2810. We omitted Zenith's SlimSport 286 because, at 9 pounds, it surpassed our 8-pound limit. Likewise, two former Editors' Choice systems—the Dynabook 286 and the Mitsuba Ninja-12 VGA—failed to meet our weight requirement. Finally, Micro Telesis submitted a notebook, but the system contained a beta ROM and could not be tested.

GETTING BETTER ALL THE TIME

What should the buyer expect to find in this product class? Based on the notebook PCs reviewed here, a 286-based machine can be purchased in the $2,000 to $4,000 price range. Most provide 1MB to 3MB of RAM, generally upgradable to 5MB. Hard disks with 20MB capacities, 2.5-inch platters, and 18- to 20-millisecond access times are typical in this group, as the 40MB 2.5-inch variety has not yet come to market. The internal 1.44MB 3.5-inch floppy disk drive is also standard on most machines.

You'll find VGA-compatible supertwist nematic or triple supertwist LCD subsystems with 640- by 480-pixel resolution and 16 to 32 gray scales. Even better, almost all the systems feature eye-saving 6- by 8-inch screen dimensions. For the most part, expansion options are limited to what can be done with one parallel and one serial port.

Despite the overall high quality of notebook displays, an external monitor port is a necessity for notebook PC users—and you'll find them on most of the machines reviewed here. Communications capacities are also vital, and all of these notebook PCs now offer (as standard equipment or as an option) an internal 2,400-bit-per-second modem with MNP level 5 compression and error-checking protocols. Many

EDITORS' CHOICE

- CompuAdd Companion
- Ogivar Internote 286
- Sanyo MBC-17NB
- Sharp PC-6220
- TravelMate 2000
- Zeos Notebook 286

If you are buying a 286, you'll want to find the bargains; otherwise you're better off getting a 386SX system. Our six Editors' Choices boil down to two machines in three variants each.

For affordability, nothing beats the $1,995 Zeos Notebook 286, manufactured by Sanyo. While the display is one step below Sharp's dazzling triple supertwist nematic screen, it's still crisp and highly readable. Sanyo and Ogivar sell the same system, with the Canadian Ogivar providing a bilingual French/English keyboard. When you apply a typical dealer discount of about 30 percent to either the Ogivar or the Sanyo version, you should come up with a bargain similar to the Zeos.

For portability, the 4.3-pound Sharp PC-6220/Texas Instruments TravelMate 2000 remains your best bet. This system wins for its lightness and for its beautiful VGA display, which supports up to 32 gray shades. With CompuAdd now marketing the system as well, you have an excellent chance of finding this system for $2,500 to $3,000. Remember, though, that unless you're particularly fond of file-transfer software, you'll need to factor in the weight and cost of the external floppy disk drive.

The requirement that a 286 notebook PC offer something a 386SX can't—whether price or portability—knocked both the $3,495 GRiD 1720 and the $3,699 NEC UltraLite 286V out of the running for Editors' Choice. While GRiD produces the only 16-MHz 286 in the lot, it leaves the user hankering for an SX processor in this handsome case. The hard-disk-only UltraLite, meanwhile, lacks the excellent display that keeps the Texas Instruments/Sharp/CompuAdd trio so intriguing, even though its 6.4-pound weight makes it slightly lighter than most 286s in this review. The UltraLite's ROM card slot is a great idea poorly executed. What little software you'll find is a year or two out of date, and the card format doesn't conform to the industry standard agreed upon last year.

Once upon a time it was at the cutting edge but the now dated Compaq LTE/286 has proved too expensive to justify its lack of a VGA display, its awkward keyboard, and its limited RAM capacity. Though we awarded this system Editors' Choice status in our issue of March 13, 1990, and gave it another enthusiastic review for the issue of October 16, we believe it is no longer worth your consideration.

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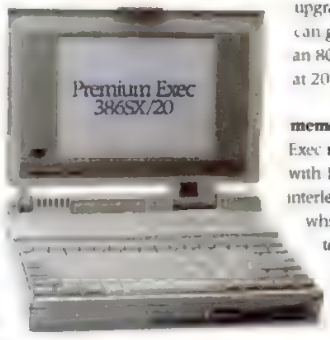

Start with the keyboard. Does it remind you of the one on your desktop computer? It should. Our keyboard has 82 keys, including function keys and dedicated word processing keys. Also, an inverted "T" cursor pad and standard key spacing mean you don't have to figure out a whole new way of typing. It'll keep your fingers happy through the most frustrating of spreadsheets.

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CIRCLE 166 ON READER SERVICE CARD

286-BASED NOTEBOOKS: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Compaq LTE/286	CompuAdd Companion	GRiD 1720	NEC UltraLite 286V	Ogivar Internote 286	Sanyo MBC-17NB
Price of standard configuration	$4,048	$2,895	$3,495	$3,699	$2,999	$2,999
Distribution channel	Dealers	Dealers, direct	Dealers	Dealers	Dealers, direct	Dealers
TESTED CONFIGURATION						
Microprocessor	12-MHz 80C286	12-MHz 80C286	16-MHz 80C286	12-MHz 80286	12-MHz 80286	12-MHz 80286
Power supply type	Battery	AC, battery	Battery	Battery	AC, battery	AC, battery
Dimensions (HWD, in inches)	1.9 x 11 x 8.5	1.4 x 11 x 8.5	1.8 x 12 x 10	1.8 x 12.3 x 9.5	2 x 10 x 12.3	2 x 12 x 10
Weight (pounds)	7.5	4.3	6.6	6.4	6.8	6.8
Display subsystem	CGA	VGA	VGA	VGA	VGA	VGA
Display area (WxH, in inches)	7.7 x 3.6	8 x 6	6.3 x 8.3	8 x 6	8 x 6	8 x 6
Display technology	Backlit supertwist LCD	Sidelit TSTN LCD	Backlit supertwist LCD	Backlit supertwist LCD	Sidelit supertwist LCD	Sidelit supertwist LCD
Motherboard manufacturer	Compaq	TI	GRiD	NEC	Sanyo	Sanyo
Chip set manufacturer	Compaq	Sharp	Headland	C&T	Oak	Oak
BIOS version	Compaq	Phoenix 3.10 00	Phoenix 1.10	Phoenix 3.10 00	Phoenix 3.10.00	Phoenix 3.10.00
Date	September 1989	January 1988	October 1990	January 1988	January 1988	March 1985
Video shadowing/System shadowing	❑ / ❑	❑ / ❑	■ / ■	■ / ■	❑ / ❑	❑ / ❑
MEMORY						
RAM (minimum–maximum)	640K–4.6MB	1MB–3MB	1MB–5MB	1MB–1MB	1MB–5MB	1MB–5MB
Installed RAM	2.6MB	1MB	1MB	1MB	1MB	1MB
RAM packaging	SIMM	Proprietary	SIMM	DIP	ZIP	ZIP
Rated speed	100 ns.	80 ns.	80 ns.	100 ns.	80 ns.	80 ns.
Chip size	256Kb, 1Mb	128Kb	1Mb	1Mb	1Mb	4x256Kb
DISK DRIVES						
Hard disk capacity and size	20MB 3.5-inch	20MB 2.5-inch	20MB 2.5-inch	20MB 2.5-inch	20MB 2.5-inch	20MB 2.5-inch
Manufacturer	Conner	PrairieTek	Conner	PrairieTek	Conner	Conner
Interface	IDE	IDE	IDE	IDE	IDE	IDE
Average access time	29 ms.	23 ms.	23 ms.	23 ms.	23 ms.	23 ms.
Controller manufacturer	Compaq	PrairieTek	PrairieTek	PrairieTek	Conner	Sanyo
Floppy disk drive capacity	1.44MB	N/A	1.44MB	1.44MB	1.44MB	1.44MB
EXPANSION BUS						
Bus speed	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz	8 MHz
Proprietary expansion slots	1 modem	1 modem	1 modem	1 modem	1 modem	1 modem
External expansion port	■	■	❑	■	❑	❑
Expansion unit available	❑	❑	❑	❑	❑	❑
Self-configuring/Single connection	N/A	N/A	N/A	N/A	N/A	N/A
VIDEO						
Video modes supported	CGA	VGA	VGA, MDA	VGA	VGA	VGA
Gray scales at max resolution	4	16	16	16	16	16
Interface	8-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Chip set manufacturer	Compaq	C&T	GRiD	Cirrus	Cirrus	Cirrus
Controller location	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard	Motherboard
Simultaneous external display	❑	❑	❑	❑	❑	❑

Editors' Choice ■—Yes ❑—No
N/A—Not applicable: The product does not have this feature.

include data transfer software such as *LapLink III* in ROM as well.

Even more vital than communications is battery life, and on this score the very best in the group go beyond 2 and a half hours on our Battery Rundown tests. Most of these machines fall in the 60- to 90-minute range. Look for disk and screen shutdown features and system standby modes, which can add considerable time to the battery life. Notebooks with features like the GRiD 1720's Resume mode (which holds applications and data in memory for a while during an accidental or intentional power-down) provide the extra data security you'll want on the road. Don't settle for less. The critical attitude to take is that 286 notebooks are the bridge solution to lightweight computing until notebooks equipped with 386 processors and higher-capacity hard disks become more readily available.

Perhaps most important, mail-order companies are beginning to have a powerful effect on the notebook computer marketplace. With the entry of more manufacturers like CompuAdd and Zeos into this laptop market segment, designs and features are likely to continue to improve as prices drop.

Clearly, notebook computing is no longer an exercise in compromise. Gone is the reliance on RAM drives and external devices to perform the most basic computer functions. A great deal more working-world computing power is packed into the

	Sharp PC-6220	TI TravelMate 2000	Zeos Notebook 286
	$3,995 Dealers	$3,999 Dealers	$2,114 Direct
	12-MHz 80C286 AC, battery 1.4 x 11 x 8.5	12-MHz 80C286 AC, battery 1.4 x 11 x 8.5	12-MHz 80286 AC, battery 2 x 12 x 10
	4.3 VGA 8 x 8 Sidelit TSTN LCD	4.3 VGA 8 x 8 Sidelit TSTN LCD	6.9 VGA 7.5 x 5.8 Sidelit supertwist LCD
	TI Sharp Phoenix 3.10 00 January 1988 ❑/❑	TI Sharp Phoenix 3.10 00 January 1988 ❑/❑	Sanyo Oak Phoenix 3.10 00 January 1988 ❑/❑
	1MB–3MB 1MB Proprietary 80 ns. 128Kb	1MB–3MB 1MB Proprietary 80 ns. 128Kb	1MB–5MB 1MB ZIP 80 ns. 1Mb
	20MB 2.5-inch PrairieTek IDE 23 ms. PrairieTek N/A	20MB 2.5-inch PrairieTek IDE 23 ms. PrairieTek 1.44MB	20MB 2.5-inch Conner IDE 23 ms. Conner 1.44MB
	8 MHz 1 modem ■ ■ ($699) ■ ■	8 MHz 1 modem/CRT ■ ■ ($699) ■ ■	8 MHz 1 modem ❑ ❑ N/A
	VGA 16 16-bit C&T Motherboard ❑	VGA 16 16-bit C&T Motherboard ❑	VGA 16 16-bit Cirrus Motherboard ❑

CONTINUES

8.5- by 11-inch form factor than there was a year ago. And you can be sure that more is on the way.

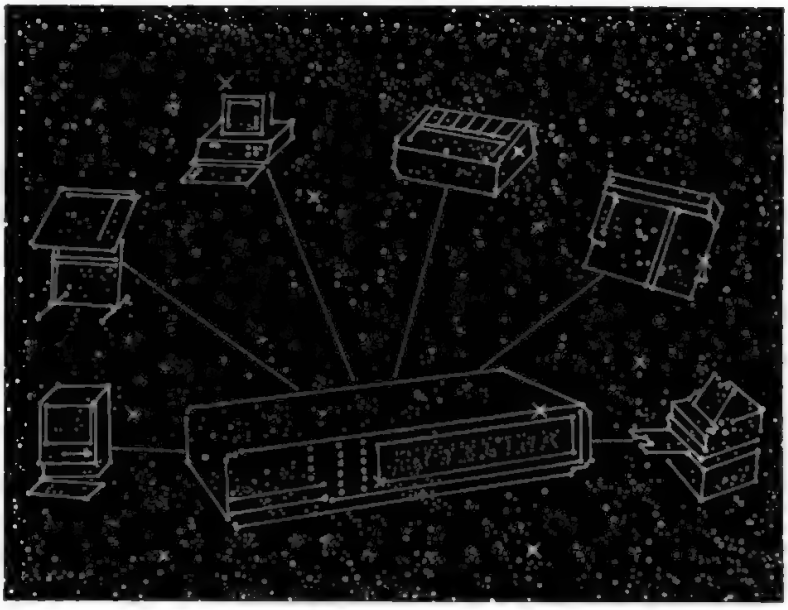
COMPAQ COMPUTER CORP.

Compaq LTE/286

by Alfred Poor

When it first appeared, the Compaq LTE/286—a lightweight, 12-MHz 80286-

STAR CONFIGURATION



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286-BASED NOTEBOOKS: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Compaq LTE/286	CompuAdd Companion	GRID 1720	NEC UltraLite 286V	Ogivar Internote 286	Sanyo MBC-17NB
KEYBOARD						
Keys: total, function, cursor	81, 10, 4	79, 12, 4	84, 12 ,4	78, 12, 4	82, 12, 4	82, 12, 4
Keypad connector/keyboard connector	■ / ❑	■ / ❑	❑ / ■	❑ / ❑	❑ / ❑	❑ / ❑
SOFTWARE						
DOS	3.3, 4.01	4.01	4.01	4.01	4.01	4.01
Disk caching software	Compaq	None	None	NEC	None	None
Expanded memory manager	CEMM	None	TEMM1720	NEC	None	OAKEMM
Other	None	*LapLink II* 2.04	None	None	None	None
COMMUNICATIONS						
Internal modem	2,400 bps ($599)	2,400 bps ($399)	2,400 bps	2,400 bps ($499)	2,400 bps ($250)	2,400 bps ($390)
V.42bis/MNP 5	■ / ■	❑ / ■	■ / ■	■ / ❑	■ / ■	■ / ■
Modem options	None	Send fax	None	None	None	None
PHYSICAL FEATURES						
Power supply (watts)	24	27	20	32	45	45
Dual voltage	■	❑	■	■	■	■
Power-on/reset switch	Top/none	Top/none	Top/none	Back/side	Side/side	Side/side
BATTERY						
Claimed battery life (hours)	3.5	2	3	2.5	2-3	3
Charge time (hours) with unit on, off	8, 1.5	2, 2	4, 2	4, 4	10, 1	10, 1
Battery voltage, Amp-hours	4.8V, 5.0 Ah	9.6V, 1.2 Ah	12V, 1.4 Ah	17V, 1.2 Ah	12V, 1.7 Ah	12V, 1.7 Ah
Shutdown:						
Display/disk	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■	■ / ■
System/peripherals	■ / ■	■ / ❑	■ / ■	■ / ❑	■ / ■	■ / ■
Transformer weight (pounds)	0.9	1.3	0.7	1.6	1.3	1.8
Transformer size (inches)	2 x 5.2 x 3.2	1.4 x 3.5 x 6.5	1 x 2 x 3	1.8 x 4.3 x 6.7	3.3 x 8.1 x 2.2	3.5 x 8 x 4.5
MISCELLANEOUS						
Car battery adapter available	■	■	■	■	❑	❑
Coprocessor supported	80C287	80287	80287	None	None	None
Setup in ROM/Password in ROM	■ / ■	■ / ■	■ / ■	❑ / ■	■ / ❑	■ / ❑
Warranty	1 year	1 year	1 year	1 year	1 year	1 year
Service	Dealer	Vendor	Dealer	Dealer	On-site	Dealer, vendor
FCC certification class	B	B	B	B	B	B
FCC identification number	CNT75M5396	A92S62T20	ACJ9TG25-3551	A3DPC-20-01	AEZ93744600	AEZ93744600

PC—Editors' Choice ■—Yes ❑—No

based laptop with a 20MB hard disk and a footprint no larger than a sheet of paper—had the potential to show why Compaq has earned a reputation for pioneering designs that expand our expectations. In this fast-paced business, however, last year's innovation is this year's baseline; the $4,048 LTE/286, with 1.6MB RAM and a 20MB hard disk ($3,499 with 640K RAM), is already showing its age.

The LTE/286 shares the 1.9- by 11- by 8.5-inch case and many of its other features with the 8086-based Compaq LTE. Like its older sibling, the LTE/286 tips the scales at more than 7 pounds—not including the AC adapter, which adds nearly a pound and a half. This common design history has no doubt helped Compaq bring the LTE/286 to market sooner but may also be responsible for many of its shortcomings.

The Compaq LTE/286 was a good choice when it first appeared on the market.

The most obvious weakness is its display. While newer designs in this class use a VGA LCD, the LTE/286 is limited to CGA with a four-shade gray scale. If you intend to use any graphics program, such as a business graphing application or *Microsoft Windows*, you hit another problem. Instead of using the standard 1:3 width-to-height aspect ratio, the 7.7- by 3.6-inch screen of the LTE/286 is more than twice as wide as it is high, which results in a squashed image. A connector is provided for attaching an external CGA monitor.

The keyboard also presents problems. While most of the keys are full-size and have standard spacing, many are reduced

	Sharp PC-6220	TI TravelMate 2000	Zeos Notebook 286
	79, 12, 4 ■ / ❑	79, 12, 4 ■ / ❑	82, 12, 4 ❑ / ❑
	4.01 SMARTDRV.SYS EMM4J.SYS *LapLink III*	4.01 None EMM4J.SYS *LapLink II* 2.04	4.01 ($119) None None None
	2,400 bps ($499) ❑ / ■ Send fax	2,400 bps ($499) ❑ / ■ Send fax	2,400 bps ($219) ❑ / ■ None
	27 ❑ Top/none	27 ❑ Top/none	43 ❑ Side/side
	2 2, 2 9.6V, 1.2 Ah	2 2, 2 9.6V, 1.2 Ah	2-3 10, 1 12V, 1.7 Ah
	■ / ■ ■ / ❑ 1.3 1.4 x 3.5 x 6.5	■ / ■ ■ / ■ 1.3 1.4 x 3.5 x 6.5	■ / ■ ■ / ■ 1.8 2.1 x 3.1 x 8
	❑ 80287 ■ / ■ 1 year Dealer, vendor B A92S62T20	❑ 80287 ■ / ■ 1 year Dealer, vendor B A92S62T20	❑ None ■ / ■ 1 year Vendor B AEZ93744600

ENDS

to about three-quarter size. The Escape, Delete, and ten function keys, which are located across the top row, are among these miniaturized keys. The Backslash key at the right edge of the keyboard is as high as the full-size keys but not as wide. The cursor control keys are arranged in an "L" pattern in the lower-right corner, a layout many people find harder to use than the more common "inverted T" pattern. And if you do adapt to the Compaq arrangement you'll probably have trouble switching back and forth between it and your desktop machine.

Compaq's 4-hour battery life beats all of the competition by more than an hour. To extend the already phenomenal run-time, the LTE/286 has a standby mode triggered from the keyboard. If the machine is left running, it will eventually go into standby automatically, but only after burning another 10 minutes at full power. If you close the cover while the power is on, there is no beep to remind you to turn it off, and the normal power-on/power-off sequence results in a reboot without any saving grace. The system takes 8 hours to charge while it's running but just 90 minutes when it's off.

Compaq LTE/286, $4,048.

The LTE/286 has a wide variety of extra-cost options. An external numeric keypad is available, as are a range of external floppy disk drives and tape backup systems. You can get a 40MB hard disk instead of the 20MB version we tested, though there is no floppy disk drive–only configuration. Additional battery packs, a fast-charging AC adapter, and a carrying case are also available. You can build up the memory to a maximum of only 2.6MB, which is a low ceiling for a 286-based computer in the days of RAM-hungry programs such as *Windows* 3.0.

The LTE/286 was a good choice when it first appeared on the market, but not even Compaq's reputation for quality design can overcome the high-priced shortcomings of the LTE/286. A new generation of 286 notebooks has hit the market, offering better displays, less awkward keyboards, more memory, better performance, and in many cases a significantly better price for the same configuration.

FACT FILE

Compaq LTE/286
Compaq Computer Corp., 20555 SH 249, Houston, TX 77070; 800-231-0900, 713-370-0670.
List Price: With 640K RAM, 20MB hard disk, 1.44MB floppy disk drive, CGA liquid crystal display, $3,499.
Options: 1MB RAM upgrade, $549; 2MB RAM upgrade, $999; 4MB RAM upgrade, $999; upgrade to 40MB hard disk, $1,199; 60MB tape drive, $799; 60MB tape cartridge, $50; external storage module, $349; external 360K floppy disk drive, $275; external 1.2MB floppy disk drive, $275; external 1.44MB floppy disk drive, $275; internal 2,400-bps modem, $449; internal 2,400-bps enhanced modem, $599; additional battery pack, $129; additional AC adapter, $149; external fast charger/AC adapter, $199; serial interface board, $149; external numeric keypad, $119; carrying case, $89.
In Short: Once a pioneer in portable 286 power, the Compaq LTE/286 pales in comparison with its more recent competition. There's no longer any reason to settle for CGA, the screen's squashed aspect ratio, the miniaturized function keys, or the L-shaped cursor arrangement.

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COMPUADD CORP.

CompuAdd Companion

SHARP ELECTRONICS CORP.

Sharp PC-6220

TEXAS INSTRUMENTS

TravelMate 2000

by Bruce Brown

The 286 notebook twosome of the Sharp PC-6220 and TravelMate 2000, which jointly won our Editors' Choice award in our issue of October 16, 1990, have recently been joined by CompuAdd Corp.'s CompuAdd Companion. There are now three versions of this superb lightweight portable, which is largely the product of Sharp design and Texas Instruments manufacturing.

What CompuAdd brings to the family is a sales channel. Sharp and Texas Instruments sell only through dealer channels, while CompuAdd sells directly via mail order and its own retail stores. The hardware on all three machines is exactly the same, except for case color and labeling. The case weighs 4.3 pounds, including the internal battery, and measures 1.4 by 11 by 8.5 inches (HWD). The AC adapter/battery recharger is 1.4 by 3.5 by 6.5 inches and weighs a mere 1.3 pounds.

Price differences among the three note-

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Two drives are better than one! First, you're getting our whisper quiet high speed, high capacity hard disk. Then we've built in an industry standard 1.44 Megabyte, 3.5 inch floppy as well. And we don't stop there.

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For instance, the battery system of your new notebook is the most advanced on the market. You can quick charge, or trickle charge, any time your system is plugged in. Or, you can use the optional charging stand if you wish.

Either way, you're sure to appreciate our light weight snap-in, snap-out battery packs. They're so light and easy to use, you can easily take an extra one with you on those really long trips. Plus, you can get even more life out of a single charge by using our programmable power management system. Hour upon hour of Notebook computing power!

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ZEOS

BENCHMARK TESTS: 286-BASED NOTEBOOKS

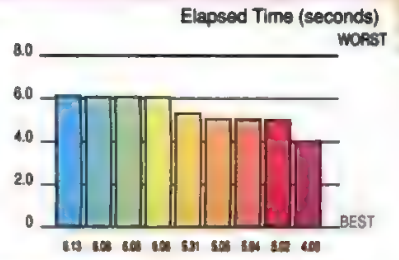
PROCESSOR AND MEMORY BENCHMARK TESTS

The 16-MHz GRID 1720 turned in the best times overall, although it suffered on the Direct to Screen test. Among the 12-MHz systems, the NEC UltraLite 286V has the fastest memory and some of the slowest disk times.

In testing one 16-MHz and eight 12-MHz 286 laptops for this section, we used PC Magazine Labs' Hardware Performance Tests, Release 5.6, with video and system shadowing enabled wherever possible, and we left the buffers at their default values. We used no software disk caches when performing disk benchmark tests, and no RAM-resident programs were loaded for any tests. The margin of error for the processor, memory, and video benchmark tests is 0.05 seconds, so take this into account when making purchasing decisions based primarily on speed.

80286 Instruction Mix

The **80286 Instruction Mix** benchmark test times a series of tasks specific to the 80286 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



Floating-Point Calculation Without Coprocessor

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.

Conventional Memory

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

books are less dramatic than they seem. In our standard configuration (which we tested), the CompuAdd Companion lists for $2,895, the Sharp PC-6220 for $3,995, and the TravelMate 2000 for $3,999. While it looks like a clear win for CompuAdd, dealers often discount computers heavily, and the Sharp and TI units are available for roughly $2,500 in New York computer stores.

The standard configuration includes a 12-MHz 80286 processor with 1MB RAM, a 20MB PrairieTek hard disk, and a 16-gray-scale VGA video with a splendid sidelit triple supertwist LCD. No internal floppy disk drive is included, but an expansion chassis port that can accept an external 3.5-inch 1.44MB floppy disk drive is provided. The expansion chassis was not available at review time and only Sharp had set the price ($699). There are also

Essentially, the three machines performed identically on the PC Labs benchmark tests.

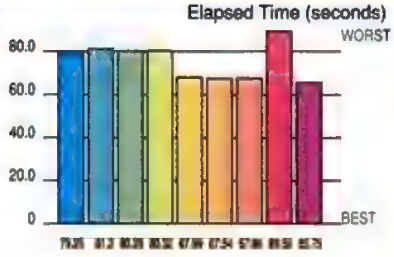
ports for parallel and serial devices, and a numeric keypad. All three notebooks come with DOS 4.01, *LapLink III* in ROM, and a *LapLink* cable for data file transfers without floppy disks. Texas Instruments' version also includes a disk caching utility, *Laptop/File Manager*, and Traveling Software's *Battery Watch*.

The sidelit triple supertwist LCD screen has an 8-by 6-inch readable area and sets a new quality level for portable displays. It is simply as good as monochrome screens that run *Windows* can get with current technology. The VGA subsystem supports up to 16 shades of gray in its maximum 640-by-480 resolution, and it can work in EGA and CGA modes as well. A standard

DISK BENCHMARK TESTS

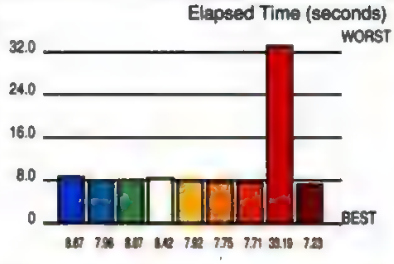
DOS File Access (Small Records)

The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.



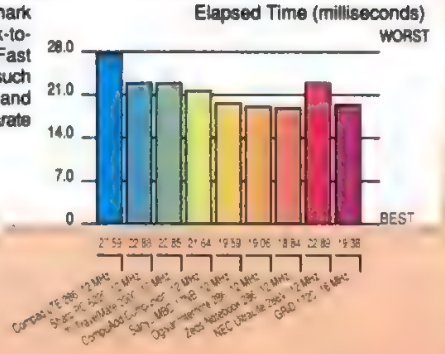
DOS File Access (Large Records)

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



BIOS Disk Seek

The **BIOS Disk Seek** benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

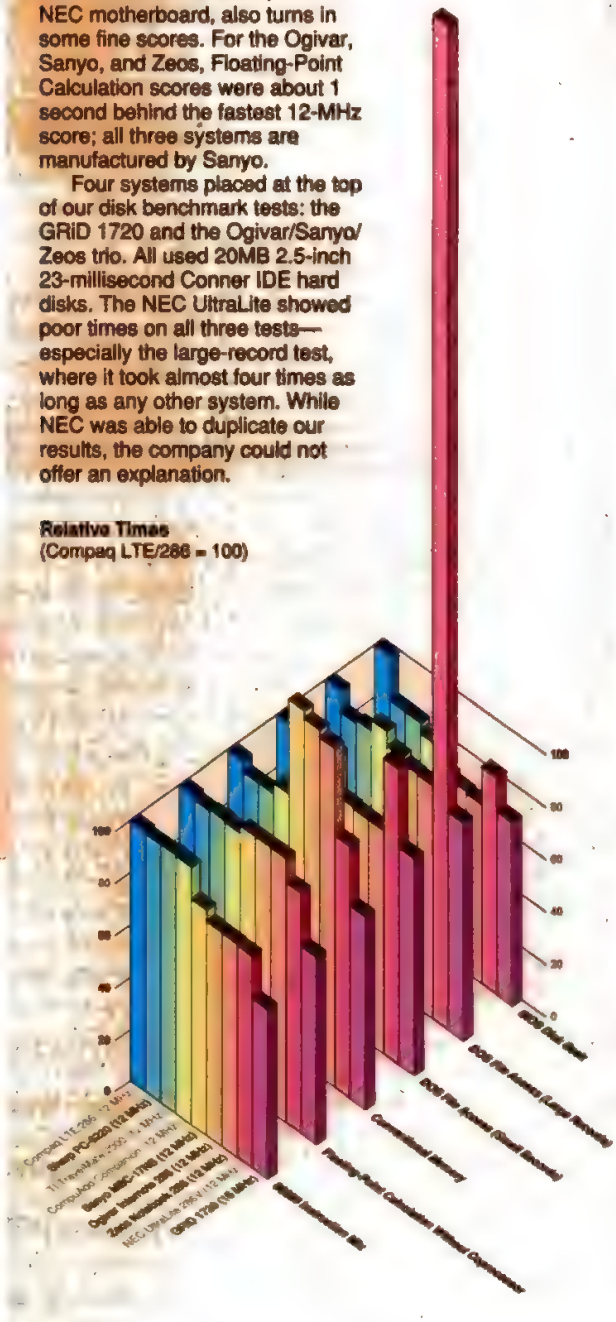


PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

While the GRiD 1720 distinguishes itself on our processor and memory tests among the machines in this section, it benefits from a 16-MHz processor. The NEC UltraLite 286V, with a NEC motherboard, also turns in some fine scores. For the Ogivar, Sanyo, and Zeos, Floating-Point Calculation scores were about 1 second behind the fastest 12-MHz score; all three systems are manufactured by Sanyo.

Four systems placed at the top of our disk benchmark tests: the GRiD 1720 and the Ogivar/Sanyo/Zeos trio. All used 20MB 2.5-inch 23-millisecond Conner IDE hard disks. The NEC UltraLite showed poor times on all three tests—especially the large-record test, where it took almost four times as long as any other system. While NEC was able to duplicate our results, the company could not offer an explanation.

Relative Times
(Compaq LTE/286 = 100)



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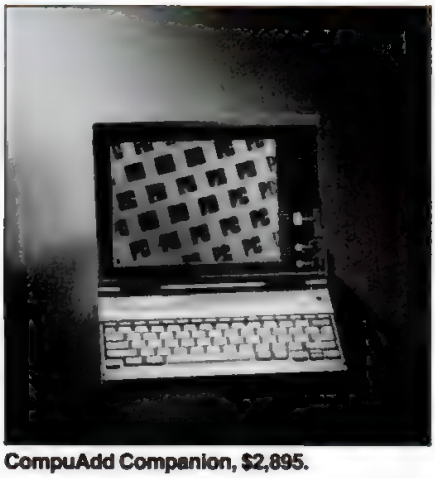


CompuAdd Companion, $2,895.

video port is not provided, but if your work or preference dictates using an external monitor, an external CRT interface ($125 for CompuAdd, $149 for Sharp or TI) adds an external VGA port.

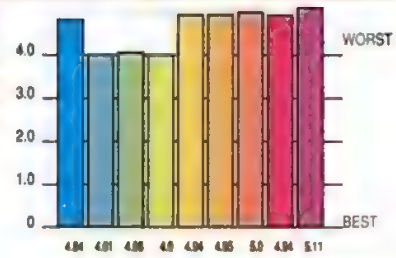
The 79-key keyboard is flat but relatively responsive. It has ten half-size dedicated function keys across the top; F11 and F12 are accessed by pressing an Fn key and tapping the F1 or F2

BENCHMARK TESTS: 286-BASED NOTEBOOKS

VIDEO BENCHMARK TESTS

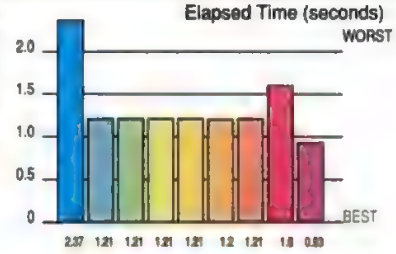
Direct to Screen

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



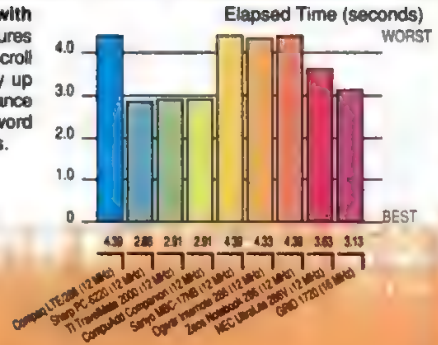
Video BIOS Routine Without Scrolling

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.



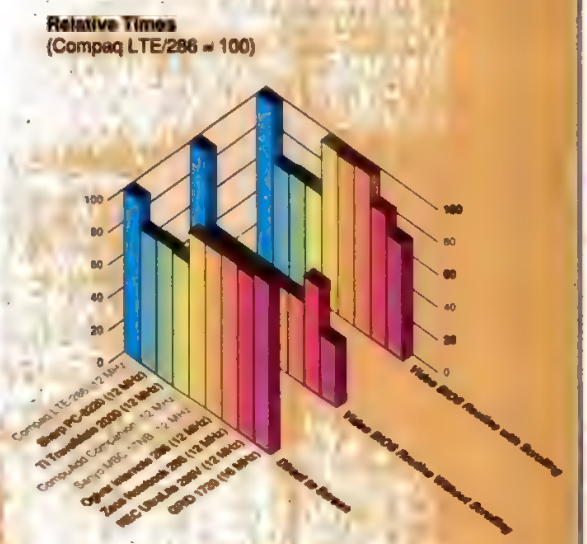
Video BIOS Routine with Scrolling

The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



VIDEO BENCHMARK TESTS: COMPOSITE VIEW

The CompuAdd/Sharp/Texas Instruments combination fared well across all three video tests; they were the top three on the Direct to Screen test and Video BIOS Routine with Scrolling, and tied with two other machines for third place on the Video BIOS Without Scrolling test. These three use 16-bit VGA, located on the motherboard, and have Chips and Technologies chip sets. Meanwhile, the Compaq LTE/286's 8-bit CGA display subsystem placed it at the bottom on both Video BIOS Routine tests.



ENDS

keys, respectively. There are also four cursor-control keys that, when combined with the Fn key, become PgUp, PgDn, Home, and End. There is no unshifted asterisk key, though there is an asterisk on the embedded numeric keypad, which itself is used by holding the Fn key or by setting the NumLock key. In case you can't live without a separate numeric keypad, there's an optional unit that CompuAdd sells for $125 and Sharp and TI for $99.

The triplets use a 12-MHz 80C286 processor that can also run at 6 or 7.16 MHz. Texas Instruments uses Sharp 286 support chips and a Phoenix ROM BIOS on the motherboard. Setup and password support are provided in ROM, and RAM can be expanded to a maximum 3MB, though the 1MB memory expansion modules are a bit pricey. CompuAdd sells them for $399, Sharp for $499, and TI for $549.

No matter which name is on the case, the CompuAdd/Sharp/TI is a top-notch machine.

Essentially, the three machines performed identically on the PC Magazine Labs benchmark tests. While slower on the 80286 Instruction Mix test than machines with similar CPUs, the CompuAdd, Sharp, and TI notebooks performed better on the Floating-Point Calculation and Conventional Memory tests. The BIOS Disk Seek test shows that the disks score well within their rated 23-millisecond times. The video test results are also quite fast, which speaks well for

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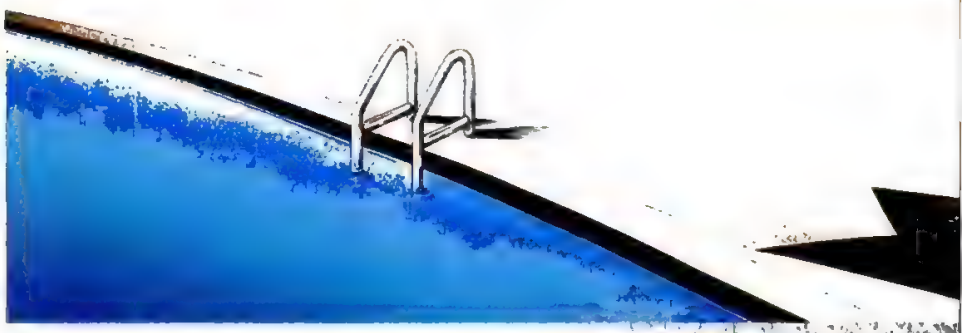

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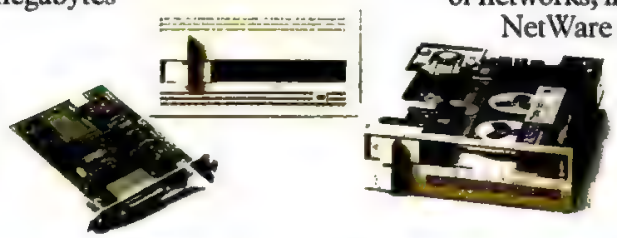

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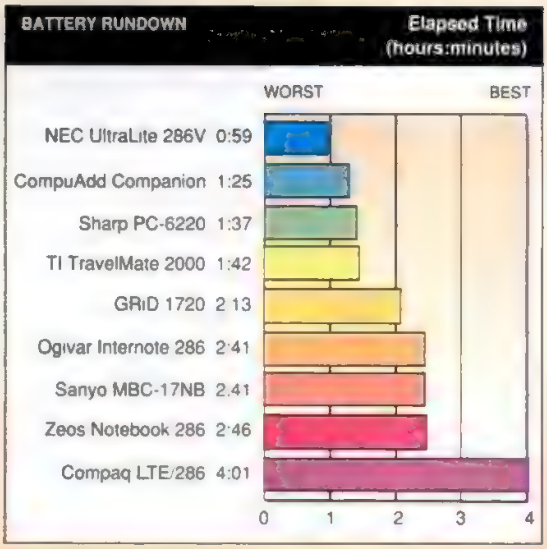
CIRCLE 495 ON READER SERVICE CARD

PERFORMANCE TESTS: 286-BASED PORTABLES

The **Battery Rundown** performance test involves teletyping five screens of text to the laptop computer's display and writing a 15K file to the hard disk, once every minute until the battery runs out of power. All power conservation techniques are disabled.



The Compaq LTE/286 turned in the best battery score, lasting 4 hours 1 minute, as opposed to the 3 hours 30 minutes Compaq claims for it. The stronger battery adds weight to the system, however: The Compaq LTE/286 tips the scale at more than 7.5 pounds. The NEC UltraLite 286V ran for 59 minutes on one battery; you can expect better performance when both batteries are installed.

We run all Battery Rundown tests with one battery and employ no battery-saving techniques. In addition, the tests access the hard disk constantly; when systems use their power-down techniques, they will probably exceed the times reported here. The 286 portables we reviewed in this issue performed as expected: Batteries with lower Amp-hour ratings ran for less time than those with higher Amp-hour ratings.

GRiD SYSTEMS CORP.

GRiD 1720

by Greg Pastrick

The 16-MHz 80C286 GRiD 1720's speed, flexibility, and light weight overshadow the usual discussion of good looks and high price. Supplied in its standard configuration for our tests, the GRiD 1720 comes with 1MB RAM, a 20MB hard disk, a 3.5-inch 1.44MB floppy disk drive, a 2,400-bps MNP5 modem, a healthy-sized triple supertwist backlit VGA display, DOS 4.01, and significant setup and power management utilities. And even if its $3,495 price tag doesn't beat the mail-order competition, the performance of this slim-profile computer from GRiD will. The only 16-MHz 286 in this roundup, the GRiD 1720 recorded top times on the 286 Instruction Mix, Conventional Memory, and DOS File Access benchmark tests.

The 6.6-pound GRiD 1720 measures 1.8 by 12 by 10 inches, and it uses an external 1- by 6- by 3.5-inch nickel cadmium battery pack. The Setup172 and Power172 utilities supplied with the GRiD 1720 define its basic parameters and make it easy to configure everything—from activating ports and BIOS shadowing to setting disk and display timeouts to conserve battery power.

GRiD 1720, $3,495.

Two complementary power management modes, Resume and Suspend, merit special mention. Resume holds applications and data in memory in case of inten-

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GRiD 1720
GRiD Systems Corp., 47211 Lakeview Blvd., P.O. Box 5003, Fremont, CA 94537-5003; 800-222-4743, 415-656-4700.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, 2,400-bps MNP5 modem, DOS 4.01, $3,495
Options: 1MB RAM upgrade, $545; 3MB RAM upgrade, $1,635; 5MB RAM upgrade, $2,725; additional battery pack, $100.
In Short: The GRiD 1720 is a top-performing, 16-MHz notebook computer. It has the features, battery power, setup, and power-saving settings you might need to finish your work, whether traveling across town or across the country.

CIRCLE 542 ON READER SERVICE CARD

tional or accidental power-down and returns the GRiD 1720 to the point where it left off, up to 24 hours later, even in the absence of battery or AC power. Suspend shuts down the system after a specified time of inactivity and automatically turns on Resume.

The GRiD 1720's triple supertwist display provides 640- by-480 resolution and shows up to 16 shades of gray. The LCD screen surface measures 8.3 by 6.3 inches. It's sharp and bright and has enough contrast to be used in any lighting. In addition, it was a top performer on the Video BIOS Routine benchmark tests. The 2.5-inch 20MB Conner IDE hard disk bettered its rated access speed of 23 milliseconds, turning in a very good 19.38 ms. on our BIOS Disk Seek test.

The GRiD 1720's 84-key keyboard has full-size, clearly labeled keys. Its 12 function keys are located across the top row, and the embedded numeric keypad is toggled with a left-hand Fn key. Fn–function key combinations can override setup and power parameters directly from the keyboard, including reverse mode, backlighting on the display, disk activity, processor speed, external display switching, and opening and closing ports. The GRiD 1720's power switch is a recessed key located above the keyboard. There is really little danger of accidentally turning off the system, since you have to hold down the key with some pressure to turn it on or off.

The GRiD-manufactured motherboard uses a Headland chip set, and the BIOS functions are handled by a Phoenix ROM. Processing speed for the 80C286 CPU can be set for 8-MHz or 16-MHz operation. Enabling the Power Management parameter in the setup utility runs the system at 2 MHz to save power in the absence of keyboard or disk activity. Our Battery Rundown test rated the GRiD 1720 at 2 hours 13 minutes power-on; an extra battery costs $100.

The GRiD 1720 is well designed, with highly competitive performance and features.

You can expand the GRiD 1720's standard 1MB of 80-nanosecond system RAM to 5MB by snapping two 2MB SIMM cards into the slot compartments located just above the keyboard. Memory

upgrades cost $545 for 1MB, $1,635 for 3MB, and $2,725 for 5MB RAM. GRiD provides TEMM 1720.SYS as its EMS driver, and for outside communications, the GRiD 1720 comes equipped with a 2,400-bps MNP5 modem with V.22 bis compatibility. Its dual RJ-11 jacks are found in the rear of the case. An 80287 math coprocessor may be added by removing the battery and opening a compartment cover in the battery bay to get at the open socket. In the same compartment there is also a switch to reverse the Ctrl and Caps-Lock keys.

The GRiD 1720 is a fine, well-designed 286 notebook with performance and features to mark it as a highly competitive, highly portable machine.

NEC TECHNOLOGIES INC.

NEC UltraLite 286V

by M. David Stone

The 286 chip may be dead on the desktop, but it can be shoehorned into a notebook computer that weighs about 6.4 pounds complete with batteries, fits easily into your briefcase, and runs circles around 8088- and 8086-based competition. The proof lies in the NEC UltraLite 286V, whose only hefty feature is its $3,699 price tag. However, the price may be worth its high degree of portability and NEC's reputation for reliability and customer satisfaction.

The UltraLite 286V measures 1.8 by 12.3 by 9.5 inches, which is about the size of two *PC Magazine* issues stacked together. Inside the box is a 12-MHz 80C286 processor, 1MB RAM, a 20MB hard disk with 23-millisecond access time, and a VGA backlit LCD. Also included in the tested base system is an AC adapter, an external 3.5-inch 1.44MB floppy disk drive, DOS 4.01, and a one-year warranty.

Although better than many LCD screens, the UltraLite's 7.8- by 5.9-inch backlit display is not as bright or as high in contrast as you might wish. There is a standard analog 15-pin port on the back of the system, however, so you can plug in a VGA monitor at home base.

NEC UltraLite 286V, $3,699.

The design of the keyboard presents a more important potential problem. Although the keys themselves provide good kinesthetic feedback, the positioning of the keyboard leaves nearly an inch of space between the Spacebar and the edge of the unit. If you rest your wrists on the desk, you're likely to hit the edge of the unit instead of the Spacebar. Be sure to type at

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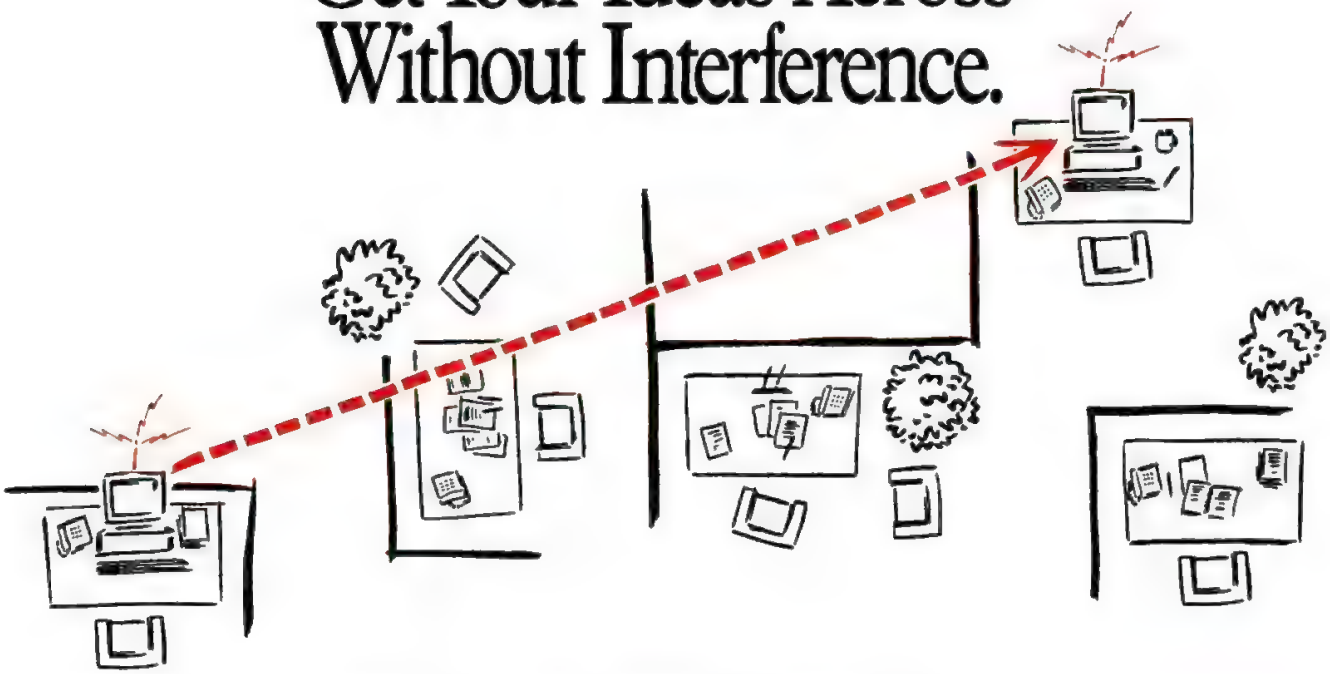

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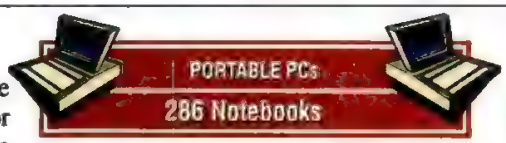


least a page or two on this system before buying it, because there is no connector for an external keyboard if you don't like the one it has.

The external 3.5-inch floppy disk drive is a mixed blessing. If you don't generally use floppy disks on the road, you save on weight and space. But if you do, the combination of the system, A/C adapter, external disk drive, and additional battery packs can quickly fill up a briefcase and make the system cumbersome to carry.

The NEC UltraLite 286V is a strong contender for those who rate portability high.

As you would expect in a notebook configuration, virtually everything is mounted on the system board. Key elements include a Phoenix BIOS, a Chips and Technologies chip set, a Cirrus VGA video chip set, and one parallel and one serial port. The hard disk controller is on the 2.5-inch PrarieTek IDE hard disk. The basic configuration comes with 1MB of 100-nanosecond surface-mounted DIP RAM. Add-in cards are available with up to 4MB additional RAM and can be installed by even the most fumble-fingered nontechnical users.

Among its relatively few options for the UltraLite, NEC offers two modems. For $499, you can have a 2,400-bps data modem with MNP4 error correction and MNP5 data compression. Alternatively, for $799 you can get a 9,600-bps fax modem with a firmware fax program. As with the memory slot, the modem slot is easy to access. NEC also offers two RAM cards ($299 for 256K and $799 for 512K) that function as drive B: in the ROM card slot. ROM cards are also available for popular applications such as *Lotus 1-2-3*.

No support is provided for a math coprocessor, but few notebook computer users are likely to be doing heavy-duty number crunching. More problematic is the lack of an upgrade from the 20MB hard disk. NEC expects a PrairieTek 40MB drive to become available within a few months.

Accessories for the UltraLite include a $139 carrying case, additional battery packs for $129, and extra AC adapters. The extra battery packs may be needed: The unit has slots for two battery packs,

FACT FILE

NEC UltraLite 286V
NEC Technologies Inc., 1414 Massachusetts Ave., Boxborough, MA 01719; 800-826-2255, 508-264-8000.
List Price: With 1MB RAM, 20MB hard disk, external 1.44MB floppy disk drive, VGA display, DOS 4.01, $3,699.
Options: 256K RAM card, $299; 512K RAM card, $799; 2,400-bps modem, $499; 9,600-bps fax modem, $799; additional battery pack, $129; carrying case, $139.
In Short: NEC keeps the UltraLite under 7 pounds by eliminating the internal floppy disk drive. While this is one of the higher-priced systems in our roundup, its 80286 Instruction Mix test results are the best among all the 12-MHz 286s tested.

CIRCLE 543 ON READER SERVICE CARD

and NEC claims 2.5-hour battery life for a fully charged pair. You'll need both batteries to get your full battery life, but the system can run for about an hour on one battery.

The UltraLite 286V is a strong contender for those who rate portability high. For $3,699 you should expect few compromises, and with the possible exceptions of the keyboard and the nuisance of carrying an external drive, NEC delivers on that expectation.

OGIVAR TECHNOLOGIES INC.

Ogivar Internote 286

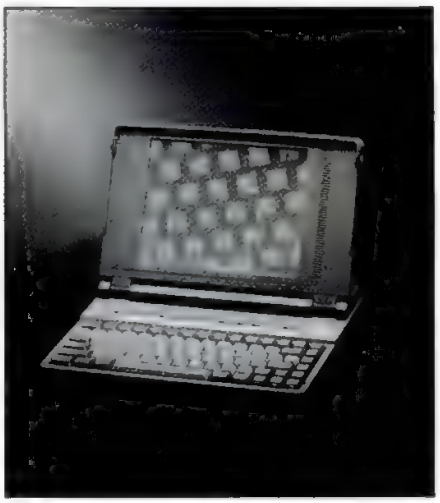
by Emerson A. Torgan

If you're looking for a 286 notebook-size computer that fits not only your briefcase but also the textual needs of French- and English-speaking clients, the Ogivar Internote 286 may be your answer. It's the same 6.8-pound, 2- by 12- by 10-inch machine as the Zeos Notebook 286, save that this Canadian entry provides a bilingual keyboard.

That keyboard doesn't come without expense. At $2,999, the Ogivar Internote basic configuration (which we tested) includes 1MB RAM, a 20MB Conner Peripheral hard disk, and a 3.5-inch 1.44MB floppy disk drive. It has one parallel, one serial, and one VGA port, a VGA LCD sidelit screen, and an AC adapter. It also comes with DOS 4.01 and diagnostic and utility programs. Apart from the bilingual keys and the bundled software, however, you can get the same setup from Zeos for about $1,000 less.

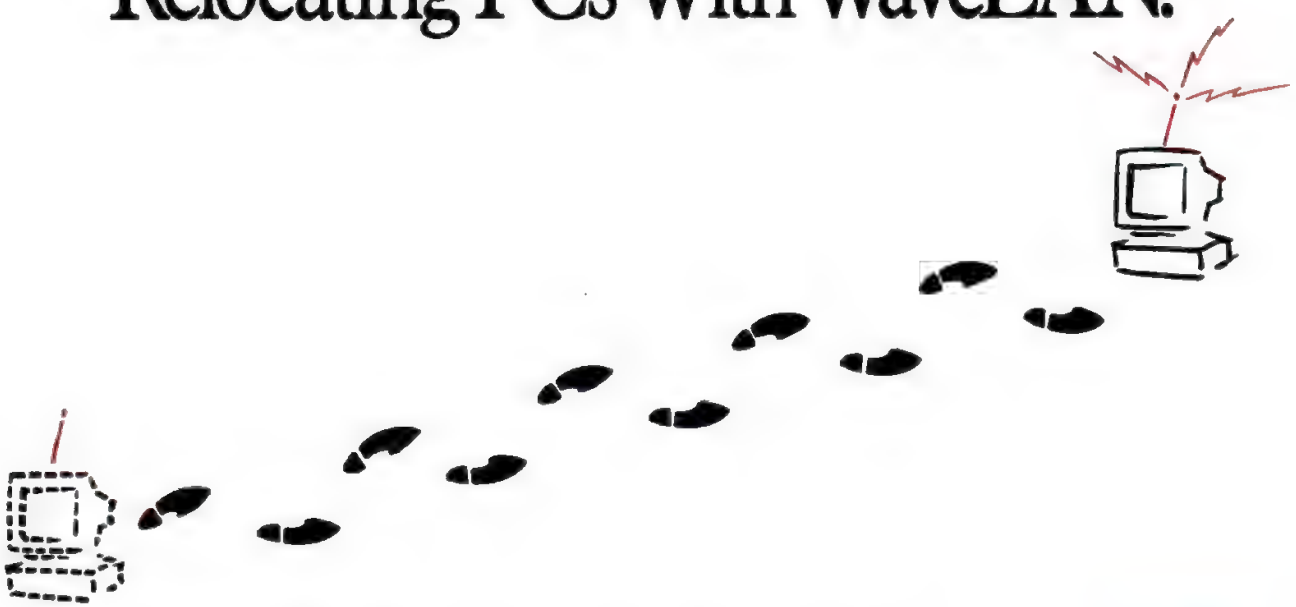
The supertwist nematic LCD, which measures 8 by 6 inches, has 640-by-480 resolution and converts VGA colors into 32 shades of gray. As with most laptops, achieving the proper combination of brightness and contrast is a delicate operation that takes some time to master. Ogivar could have made the task of adjusting the screen easier by relocating the knobs away from the right front edge or by reducing their effect; on the screen we tested, it was too easy to lose the display with an accidental brush with the fingertips. Once optimum balance is achieved, however, the screen is relatively easy on the eyes in almost any light. Provision is also made for attaching an external VGA monitor.

The 82 keys of the Internote 286 keyboard emulate a 101-key keyboard. Space is always at a premium in 286 notebook-size computers, and some keys must be sacrificed or piled one on top of another. Ogivar accomplishes this by stacking the



Ogivar Internote 286, $2,999.

A Step-By-Step Guide To Relocating PCs With WaveLAN.



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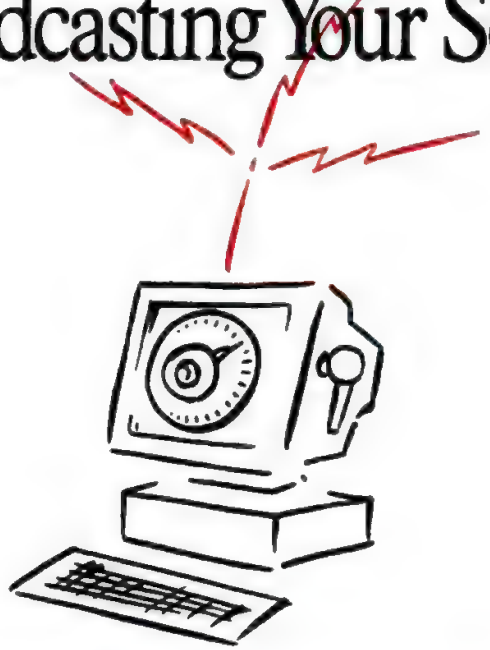

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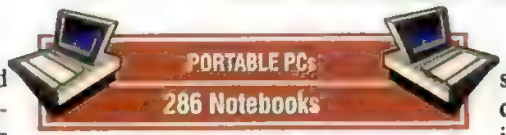


arrow keys on PgUp, Home, PgDn, and End, and using the Fn key to select the desired response. Function keys run along the top row, and if your personal preference in touch response leans toward the sluggish, you won't be disappointed. The Internote 286's most outstanding feature is its bilingual keyboard, which offers the full complement of French accent marks.

The Ogivar Internote 286 has the ability to transcend at least one language barrier.

The Internote 286's scores on PC Magazine Labs' benchmark tests were less than outstanding. In most cases the machine turned in less than average scores compared with the other 286 laptops. Its brightest spots were the 80286 Instruction Mix and the small-record DOS File Access test, where its scores were average and slightly better than average, respectively.

The Internote 286 did turn in a great time of 2 hours 41 minutes on our Battery Rundown test, where only the Zeos, Compaq, and Sanyo machines outlasted it. You can expect even better battery performance from the Internote 286 thanks to its many power-saving features, such as a user-adjustable hard disk power-down mode that can be set to take effect after 1 to 127 minutes of inactivity. Software-controlled screen blanking and the ability to cut the brightness of the screen by half (while still remaining readable) also contribute to the extended life of the battery pack. The AC adapter will fast-charge the battery in an hour, or trickle-charge it while the machine is in use within about 2 to 3 hours, depending upon the operations you have running.

Ogivar Technologies offers a variety of options, such as an internal 2,400-bps modem card ($250), 2MB memory upgrade modules ($350) for a maximum of 5MB, additional battery packs ($99), a charging stand to keep fresh power on hand at home or in the office ($50), and a leather carrying case ($125).

Take the Internote 286 on the road with one fully charged nickel cadmium battery pack and you'll have more than 2 hours of computing potential swinging from its built-in handle. All things considered, the Internote 286 is worth consideration as a convenient 286-based laptop computer

FACT FILE
EDITORS' CHOICE

Ogivar Internote 286
Ogivar Technologies Inc., 7200 Trans Canada Hwy., St. Laurent, Quebec, Canada H4T1A3; 800-361-3694, 514-737-3340.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, VGA display, DOS 4.01, $2,999.
Options: 2MB RAM upgrade, $350; internal 2,400-bps modem card, $250; additional battery pack, $99; recharging stand, $50; additional AC adapter, $125; leather carrying case, $125.
In Short: The 20MB hard disk and internal floppy disk drive make this notebook-size entry convenient on the road. A bilingual keyboard, a 10-inch screen, and over 2.5 hours of continuous operation also make the unit a welcome addition to the international business traveler's briefcase.

CIRCLE **544** ON READER SERVICE CARD

that offers the international business traveler the reliability of two disk drives, a good display, and the ability to produce screen characters that transcend at least one language barrier.

SANYO BUSINESS SYSTEMS CORP.

Sanyo MBC-17NB

by Tom Unger

Eighteen months ago, any manufacturer that could pack a 12.5-MHz 80286 processor, 1MB RAM, a fast 20MB hard disk, a 1.44MB floppy disk drive, and VGA graphics displayed on a backlit supertwist LCD screen into a 2- by 12- by 10-inch notebook package weighing less than 7 pounds would have been crowned King of the Laptops.

The $2,999 Sanyo MBC-17NB certainly fits that description and more than holds its own in this class. In fact, this system helps define the class, as both Ogivar and Zeos resell the same basic unit through their own channels. Remember this when you approach your dealer, for you should be able to get the Sanyo system for a price that comes closer to Zeos's $1,995 price tag.

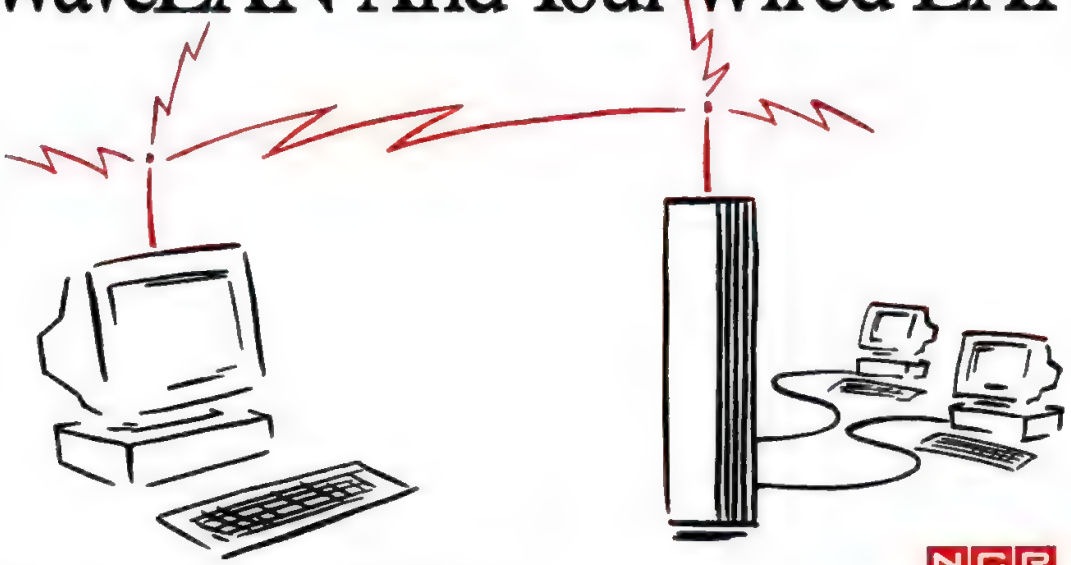
This machine comes with a 23-millisecond 20MB Conner Peripherals hard disk, a 1.44MB TEAC floppy disk drive, and a bright VGA backlit LCD screen. The basic configuration comes with 1MB of 80-nanosecond RAM, upgradable in 2MB increments to 5MB. The RAM, which costs $775 for 2MB, comes in a ZIP configuration and is user-installable. The machine includes parallel, serial, and 8-bit VGA video ports accessible from a drop-down back panel. A dedicated modem slot accepts Sanyo's own $390 internal 2,400-bps modem. Included with the system are DOS 4.01, GW-BASIC, and a variety of utilities.

Regardless of the lighting situation, from dim airplanes to harsh fluorescent-lit offices, the MBC-17NB's 8- by 6-inch screen provides a crisp, bright, highly readable display for graphics and text in a range of conditions. The 83-key keyboard has an excellent feel with near full-travel keyposts and dedicated cursor keys in the familiar AT-style "inverted T" arrangement.

Sanyo MBC-17NB, $2,999.

The MBC-17NB is small, light, and very easy to use. It lacks an auto-resume feature and ROM-based battery-monitoring software—features we have come to view as basics in other battery-powered laptop computers.

There's A Simple Connection Between WaveLAN And Your Wired LAN.



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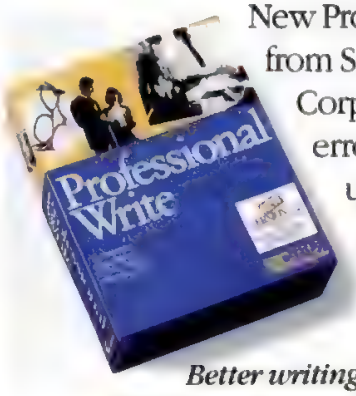

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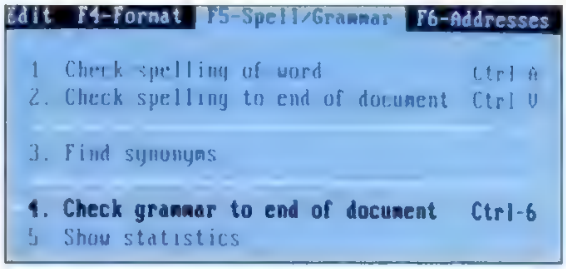

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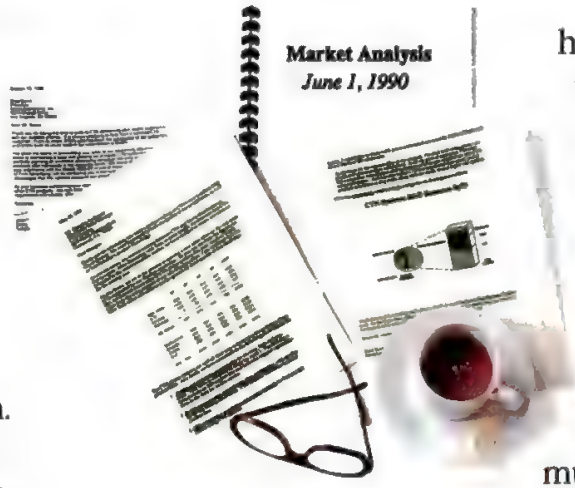

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PC FACT FILE

EDITORS' CHOICE

Sanyo MBC-17NB
Sanyo Business Systems Corp., 51 Joseph St., Moonachie, NJ 07074; 201-440-9300.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, $2,999.
Options: 2MB RAM upgrade, $775; 2,400-bps modem, $390; additional battery pack, $155; external battery charger, $120; numeric keypad, $155.
In Short: This is a rugged, fairly priced notebook computer. Easily installed RAM, long battery life, and a crisp display are among its strong points. Until Sanyo ships its 386SX-based MBC-18NB, which promises to be everything the MBC-17NB is and more, this system is a solid choice.

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To its credit, the MBC-17NB does flash a warning LED when the battery is low, and it provides numerous power-management features, easily adjusted via its ROM CMOS setup screen. But to get an audible alarm you'll need to load ALARM.COM, a software utility Sanyo bundles with the machine. ALARM.COM causes the speaker to beep when you close the cover on a powered-up unit or when the battery is low; the utility also notifies you when the machine is about to shut down. Even so, an auto-resume feature safeguarding data in RAM would add an extra margin of data safety.

The MBC-17NB comes with an excellent 10-cell nickel cadmium battery pack that powered the machine for nearly 2 hours 45 minutes—among the best of all laptops we reviewed in this issue—even with the power-management features turned off. The 1.1-pound battery can be recharged in 1 hour or less by Sanyo's 1.8-pound 45-watt AC adapter, which allows you to trickle-charge the battery while you work or work without the battery installed. Additional batteries are available from your Sanyo dealer for $155, and a stand-alone single-battery charger is available as well for $120.

Sanyo provides a one-year parts-and-labor warranty and asks its users to return troubled units to their dealers for repair. The manufacturer will swap defective warranted parts for working components on request, and it maintains both a technical support hot line and a 24-hour bulletin board service for technical questions, price updates, and dealer and ordering information.

The MBC-17NB is a rugged representative of the 286-notebook class, but you may want to wait for the machine Sanyo has in the wings, the MBC-18NB.

The MBC-17NB is a rugged representative of the 286-based notebook class, but you may still want to wait for the machine Sanyo had in the wings at the time this review was written: the 386SX-based MBC-18NB. According to a manufacturer's rep-

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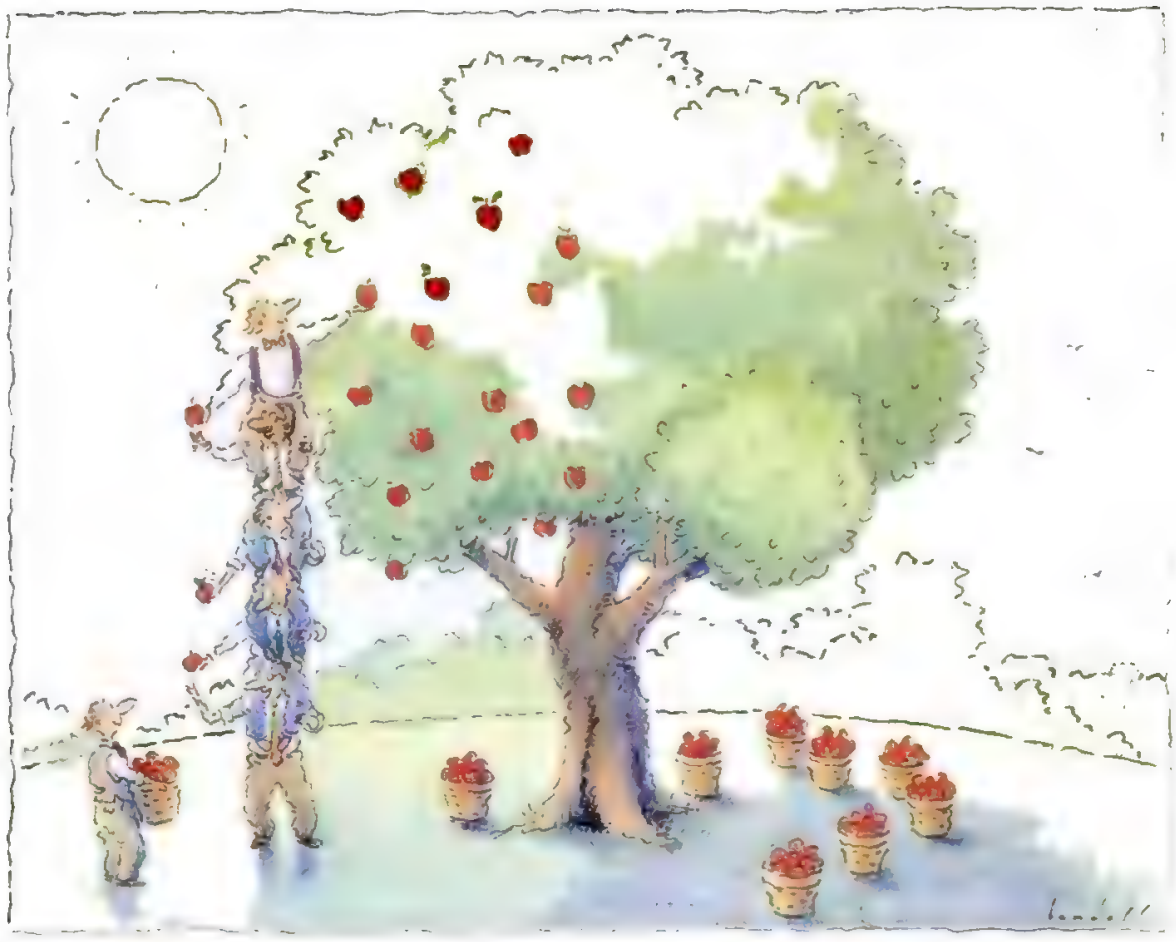

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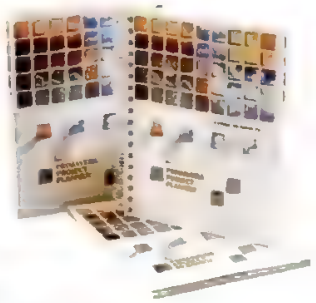

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resentative, the 18NB promises to fill in the 17NB's gaps with an auto-resume feature. That may well be worth the added cost and the wait.

ZEOS INTERNATIONAL

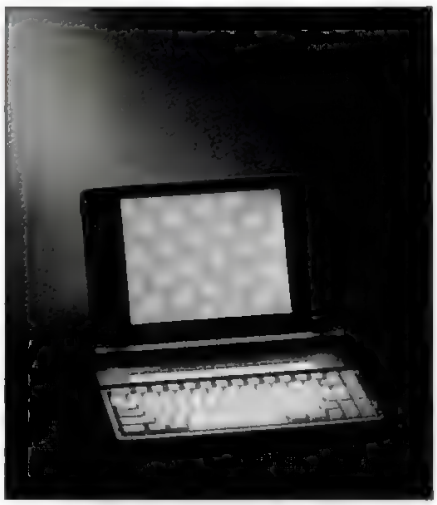
Zeos Notebook 286

by Bruce Brown

Competitors will have to scramble to match the price/performance ratio of the new Zeos Notebook 286. Currently the hottest deal on the notebook market, the Notebook 286 packs 1MB RAM, a 20MB 25-millisecond Conner Peripherals hard disk, a 1.44MB floppy disk drive, a backlit supertwist VGA LCD with 32-shade gray scale, parallel and serial ports, an external VGA port, and DOS 4.01 into a standard configuration that costs only $2,114. Our more fully loaded test machine, with an internal 2,400-bps MNP5 modem, a ZEEM driver, and a group of utilities, still came to only $2,333.

The black-cased Notebook 286 measures 2 by 12 by 10 inches and weighs 6.8 pounds, including the internal battery. Its AC adapter/battery charger is fairly large, however, measuring 2.1 by 3.1 by 8 inches and weighing 1.8 pounds.

The Notebook 286's 8- by 6-inch supertwist nematic screen has a 640-by-480 VGA resolution and can display up to 32 shades of gray. It is also downward-compatible with CGA and EGA modes. Although its LCD screen is not as sharp as the triple supertwist display of the CompuAdd/Sharp/Texas Instruments 286 notebook machine, it is nonetheless very bright and certainly acceptable. The standard 15-pin VGA port for an external monitor is a convenience for those who want color or a larger monitor when they're not actually traveling.



Zeos Notebook 286, $2,333.

The 82-key keyboard is very quiet in operation and has a nice layout that places 12 full-size function keys across the top. An Fn key on the left side activates the embedded numeric keypad and the PgUp, PgDn, Home, and Enter keys, which reside above the four cursor keys. No unshifted asterisk key is provided.

The Notebook 286's 12-MHz 80C286 motherboard is manufactured by Sanyo and uses Oak Technologies' 286 chip set and a Phoenix ROM BIOS. The CPU can run at 8 or 12 MHz. The system uses proprietary-format surface-mount memory modules that put a maximum of 1MB on the motherboard and another 4MB on special 2MB add-on modules. As with many notebook and laptop machines, however,

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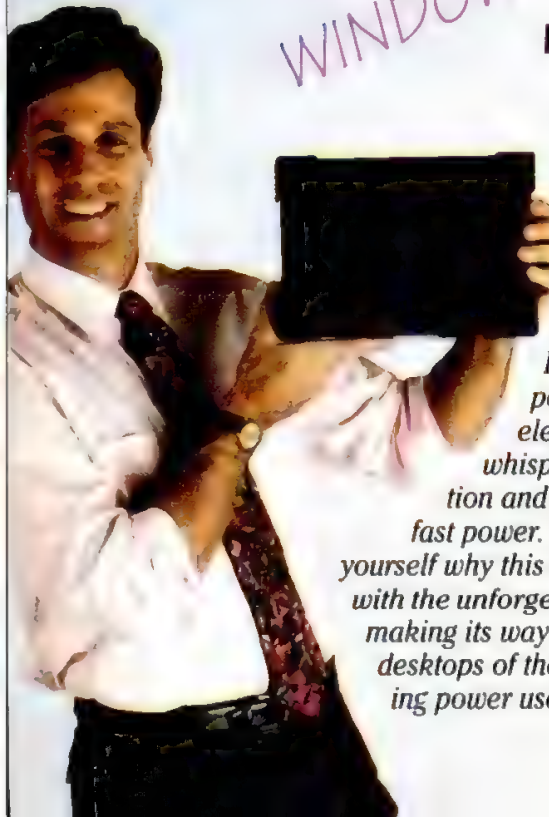

Customers and critics alike are praising the Brick for its portability, elegant design, whisper quiet operation and screamingly fast power. Find out for yourself why this diminutive PC with the unforgettable name is making its way onto the desktops of the most demanding power users.

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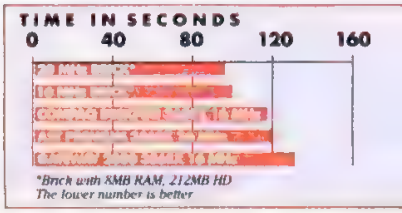
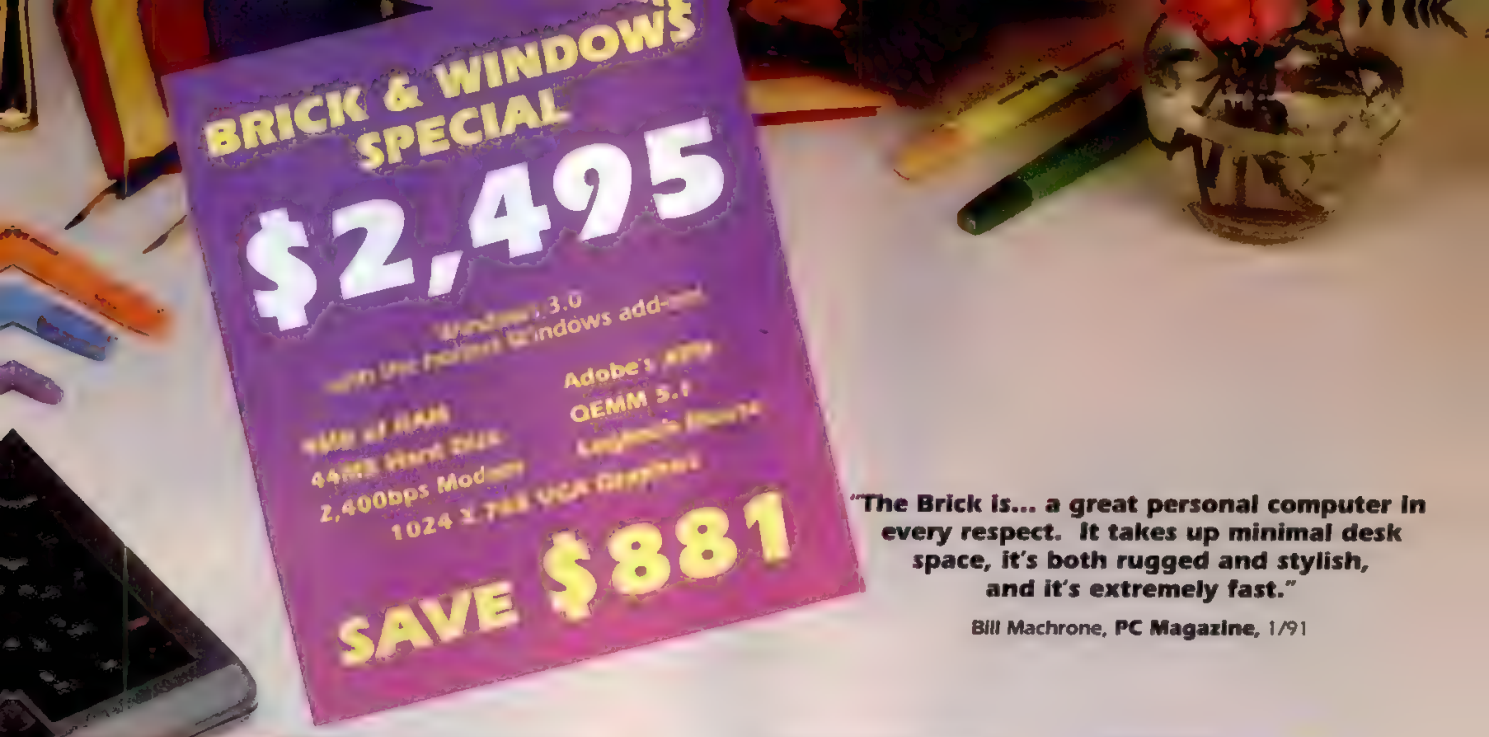
Compared to published reports of **all** 386SX machines tested to date by *PC Magazine*, the Brick offers superior performance on the aggregate of

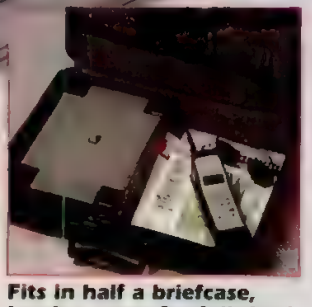


Time to complete PC Magazine's full benchmark test set.



"The Brick is... a great personal computer in every respect. It takes up minimal desk space, it's both rugged and stylish, and it's extremely fast."

Bill Machrone, PC Magazine, 1/91



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system, video and hard disk benchmarks.

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12/90, Eric Grevstad

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Jerry Pournelle **Byte**, 1/91,

The fast VGA graphics feature up to 1024 x 768 non interlaced resolution with a full 1 MB of video memory. In fact, the Brick's video performance is twice as fast as the average of 42 386SX systems tested to date by *PC Magazine!*

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9/90, Matt Ross

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memory expansion is rather expensive: It costs $349 to go from 1MB to 3MB and $649 to jump from 1MB to the 5MB system maximum.

If 286 performance is sufficient for your needs, the Zeos Notebook 286 is hard to pass up. It's the hottest deal on the notebook market.

The Notebook 286's benchmark scores were quite respectable in comparison to the other PCs, with a fast 80286 Instruction Mix score, relatively slow Floating-Point Calculation and Conventional Memory scores, very good disk test scores, and average to slow video times.

Perhaps more significant was the Battery Rundown test, on which the Notebook 286 lasted an impressive 2 hours 46 minutes, exceeding its claimed 2.6-hour life. Recharging takes only 1 hour, with the system on or off. The 12-volt battery is assisted by screen, hard disk, and CPU shutdown features, which can each be set to begin saving power after anything from 1- to 127-minute intervals of inactivity. For long trips, an extra 1.1-pound battery costs a reasonable $89; a separate recharging stand with an extra battery sells for a total of $139.

Other options for the Zeos Notebook 286 include an internal 2,400-bps MNP5 modem ($219) and a carrying case ($79). Unfortunately, there is no provision for an expansion chassis.

Zeos International sells only through mail order, but its service and support policies received high marks from *PC Magazine* readers in the survey discussed in our issue of September 25, 1990 ("Desktop PCs: The Long Road to Reliability"). In addition to a 30-day money-back guarantee, its one-year parts-and-labor warranty covers one-way shipping charges for in-warranty service, and its toll-free technical support lines are complemented by express parts shipping for any DOA or defective components.

If 286 performance is sufficient for your needs, the Zeos Notebook 286 is hard to pass up. ■

FACT FILE

EDITORS' CHOICE

Zeos Notebook 286
Zeos International, 530 5th Ave. NW, St. Paul, MN 55112; 800-423-5891.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, 32-shade backlit VGA liquid crystal display, one parallel and one serial port, VGA port, DOS 4.01, $2,114.
Options: 2MB RAM upgrade, $349; 4MB RAM upgrade, $649; VGA monitor, $399; 2,400-bps MNP5 modem, $219; additional battery pack, $89; charging stand and additional battery, $139; carrying case, $79.
In Short: The Zeos Notebook 286 is a fine lightweight 286 machine with an aggressive price/performance mix. Add a company with a growing reputation for service and support, and you have a recipe for portable computer success.

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Upgrade program	**Yes**	**No**
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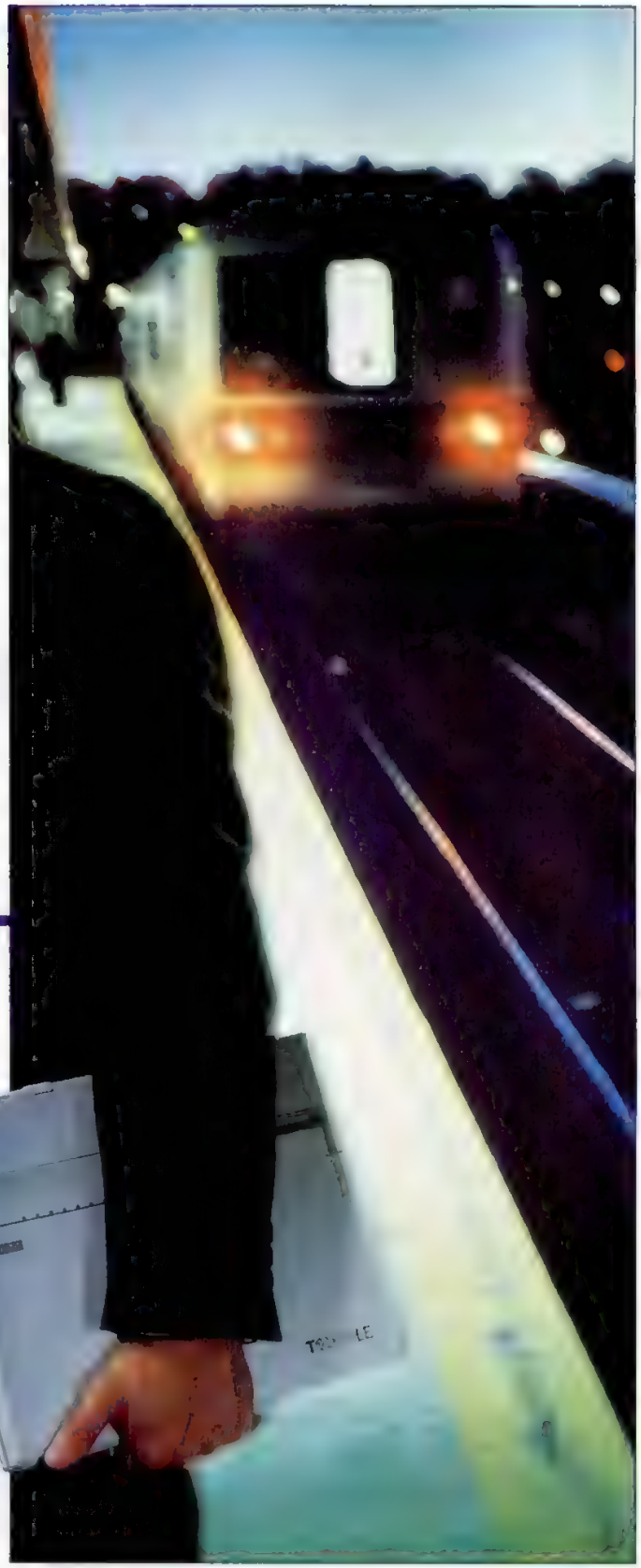
8086-Class Notebooks



PHOTOGRAPHY: JOHN WILKES

In a world where memory capacities are measured in megabytes, there are still many applications for which an 8086-class laptop represents the most appropriate technology.

by Alfred Poor

New technology like 80486 processors and giant hard disks in tiny packages may get the lion's share of the news, but when it comes to portable computing, many of us will do just as well with a kitten as a man-eating cat.

The fact is that 8086-based notebooks are alive and well. Although we are looking only at 8086s in this section, other processors that may be found in this class include Intel's 8088 and NEC's V20 and V30. These processors offer a number of design advantages and keep overall costs down compared with more powerful systems. And not everyone needs to carry the full power of a desktop system in his or her briefcase.

That said, we present three diminutive notebook computers: Compaq's $3,048 LTE, Psion's new $2,995 MC6000, and Toshiba's new $2,499 T1000LE. Each of these models makes up in light weight, convenience, and pure simplicity what its processor and motherboard lack in MIPS and megabytes.

Our choice of 8086-class portables was based on market leadership: Compaq and Toshiba systems are consistent best-sellers in this category. We requested NEC's V30-based Ultralite, as well, but the company declined our offer to participate in this review. We also made one exception to the market-leadership position. The Psion MC6000 represents such a departure from present technology that we were curious to see how this system compared with the standards. In all three cases, our only criterion was that the systems come with 1MB of RAM.

These low-end, 8086-based laptops offer some significant advantages over their bigger-brained brethren.

LIGHTWEIGHT TRADE-OFF

On the road, many users are willing to forgo their desktop computers' processing power in return for briefcase access to simple spreadsheets, unembellished word processing, and dial-in facilities for electronic mail or on-line databases.

Once the user returns to the office, the files on the laptop can be easily transferred to the desktop system for final editing, formatting, and printing. Indeed, many laptops now include floppy disk drives for simple data transfer. Some vendors bundle file-transfer programs, such as Rupp Technology's *FastLynx* or Traveling Software's *LapLink*. In most of these cases, you needn't have a copy of the program on both machines; the laptop can install a copy on the receiving machine. A few even have the transfer program loaded into the laptop's ROM, so you can't lose it even if you lose power (see our comparative review of nine file-transfer packages in this issue).

Even so, typical notebook laptop users don't require much in the way of storage. Not only can most programs fit comfortably on a single 1.44MB floppy disk with room for data files, but the use of laptop notebooks has helped spawn the latest round of compact and integrated programs. Software publishers have introduced smaller, simpler versions of their main products, such as WordPerfect Corp.'s *LetterPerfect*. These transportable versions can trade files with the full-blown desktop versions but are small enough to fit on a high-density floppy and still leave lots of room for document files.

Some of the 8086-class laptops that can be found today, like the Compaq LTE and the Toshiba 1000LE, hold 20MB hard disks—twice the storage of an original IBM XT's hard disk in a package less than a tenth its size.

MISERLY

These low-end laptops not only have the power and the storage required to do the job but offer some significant advantages over their bigger-brained brethren. Depending on your needs, such factors can make a decided difference when it comes time to lay your money down.

As a class, 8086-based designs offer advantages over portables with 80286- or 80386-based processors. For example, batteries can be smaller and will last longer between charges. Furthermore, because of their reduced power requirements, some 8086-based machines can take advantage of standard battery technology. The Psion MC6000, for instance, runs for up to 20 hours on just eight standard alkaline penlight batteries. You can even use rechargeable nickel cadmium batteries that give you 17 hours per set. The ability to *buy* new batteries in the airport adds a lot of credibility to the idea of a truly portable computer.

Lower power requirements also mean

EDITORS' CHOICE

• A WISER CHOICE: 286

Last year, we picked the floppy-disk-only Toshiba T1000SE as the best overall 8086-class notebook and the NEC Ultralite as a nice alternative. The three machines reviewed here fail to offer a compelling reason to add to those recomendations. For the money you'd spend on a Psion, a T1000LE, or a Compaq LTE, you should invest in a 286 notebook.

With list prices of over $2,500 and street prices that fall within the $1,500 to $2,000 range, the hard-disk equipped Compaq LTE and Toshiba T1000LE are significantly more expensive than the floppy-only versions of the same machines. For example, the Compaq LTE without a hard disk lists for $1,999, while the Toshiba T1000SE now lists for $1,499. Street prices for these floppy-based notebooks can go down to $1,000, perhaps lower.

All three models in this review are priced at or above the same point at which many of the latest 80286 notebooks offer the same storage and memory, higher-resolution screens, and faster performance. It is hard to justify spending this much on an 8086-class machine when you can buy a 286 version for just a bit more.

Today, we no longer believe that you should buy an 8086 laptop in any form. Single-floppy-disk-drive units such as the T1000SE or a stripped-down version of the Compaq LTE are much too limiting, while hard-disk-only units like the T1000XE are too awkward when you need to transfer files, and floppy-plus-hard-disk units aren't significantly cheaper than 286s. While we won't confer an Editors' Choice stamp of approval on any of the three units reviewed this time, if you must choose among them, we suggest either the Toshiba T1000LE or Compaq LTE. The Toshiba T1000LE has the better keyboard and a larger display, but battery life is poor. The Compaq LTE has a smaller footprint and better battery life, but its screen is cramped and the cursor keys are awkwardly arranged.

The Psion MC600 is too expensive and too different. It is truly high-tech, but its lack of any screen backlight makes it of interest only to those who want to be able to run for a day or two on just penlight batteries.

THE VERRAN AC DATALINK SYSTEM

Now, *automatic* printer-sharing for up to seven PCs ...

without computer cabling!

Until now, printer-sharing has been an awkward business.

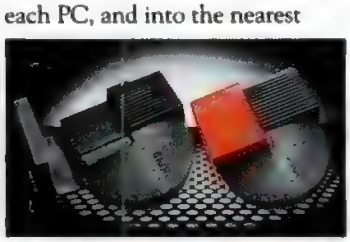
Cable, cable, cable. T-switches. Finding the right connectors. Using signal boosters if you're using a parallel printer more than a few feet away.

The more PC users you add, the more complex it becomes. And what happens if even one person needs to move offices?

At last, there's a solution.

PC printer-sharing – through the electricity supply!

The AC DataLink system consists of two components. An AC DataLink which plugs into the parallel – or serial – port of each PC, and into the nearest electrical power point. And a single AC DataLink DPS (Dedicated Printer Sharer) which plugs into a power point, and into the printer you want to share.



Both the AC DataLink ($345) and the AC DataLink DPS ($395) come complete with cables, plugs, manual, guarantee, plus Hotline registration.

The data simply passes through the electricity supply using any PC software's normal PRINT command. At the receiving end, the AC DataLink DPS *automatically* controls queuing, organizing documents into order as they're received from the PCs.

The system's suitable for virtually any PC, and any printer with a parallel (Centronics) port; the overwhelming majority.

Fast, flexible, connection freedom!

At a stroke, you can forget the tangle of expensive cabling – you've all you need in your electrical circuits!

Forget being tied down to a fixed cable layout – moving either printer or PC user is as simple as shifting the hardware anywhere you please and just plugging in.

Forget flicking T-switches and checking if other users have finished – queuing is controlled automatically within the AC DataLink DPS's 32K buffer.

You can even forget the 15 ft limit for PC-to-parallel printer connection. The AC DataLink system means that users needn't share the same office to share the same printer!

Features

Security: over 4 million codes to encrypt data.
Error detection: detects 99.99996% of all errors.
Speed: up to 840 characters per second.
Range: up to 300 ft.
FCC and UL approved.

FIND OUT MORE ABOUT AC DATALINKS, TODAY!

For full information on cable-free printer-sharing – and the other applications of the AC DataLink system, including PC to modem or plotter connection, and terminal to minicomputer connection – write for a brochure. Or simply phone our hotline during normal office hours (Eastern Standard Time).

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CIRCLE 101 ON READER SERVICE CARD

8086-BASED PORTABLES: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	Compaq LTE	Psion MC600	Toshiba T1000LE
Price of standard configuration	$3,048	$2,995	$2,499
Distribution channel	Dealers	Dealers, direct	Dealers
TESTED CONFIGURATION			
Microprocessor	9.54-MHz 80C86	7.68-MHz 80C86	9.54-MHz 80C86
Power supply type	Battery	Battery	Battery
Dimensions (HWD, in inches)	1.9 x 11 x 8.5	1.9 x 12.4 x 8.9	2 x 12.2 x 9.8
Weight (pounds)	7.1	5.2	6.6
Display subsystem	CGA	CGA	CGA
Display area (WxH, in inches)	7.7 x 3.8	8.2 x 5.1	7.5 x 4.3
Display technology	Backlit supertwist LCD	Unlit LCD	Sidelit supertwist LCD
Motherboard manufacturer	Compaq	Psion	Toshiba
Chip set manufacturer	Compaq	Intel	Toshiba
BIOS version	Compaq	Award 53.1C	Toshiba 1.20
Date	9/15/89	9/18/90	8/24/90
Video shadowing/System shadowing	❑ / ❑	❑ / ❑	❑ / ❑
MEMORY			
RAM (minimum–maximum)	640K–1MB	640K–640K	1MB–9MB
Installed RAM	1MB	640K	1MB
RAM packaging	SIMM	SIMM	DIP
Rated speed	100 ns.	120 ns.	80 ns.
Chip size	256Kb, 1Mb	256Kb	1Mb
DISK DRIVES			
Hard disk capacity and size	21.4MB 3.5-inch	N/A	20MB 2.5-inch
Manufacturer	Conner	N/A	Conner
Interface	IDE	N/A	IDE
Average access time	29 ms.	N/A	23 ms.
Controller manufacturer	Compaq	N/A	Conner
Controller location	Motherboard	N/A	Motherboard
Floppy disk drive capacity	1.44MB	1.44MB (external)	1.44MB
EXPANSION BUS			
Bus speed	8 MHz	8 MHz	9.54 MHz
Proprietary expansion slots	1	1	2
External expansion port	■	■	■
Expansion unit available	❑	❑	■ ($1,199)
Self-configuring/Single connection	N/A	N/A	■ / ■
VIDEO			
Video modes supported	CGA	CGA	CGA, ATT 6300
Gray scales at maximum resolution	4	8	2
Interface	8-bit	8-bit	8-bit
Chip set manufacturer	Compaq	C&T	Toshiba
Controller manufacturer	Compaq	Psion	Toshiba
Controller location	Motherboard	Motherboard	Motherboard
Simultaneous external display	❑	■	❑
KEYBOARD			
Keys: total, function, cursor	81, 10, 4	76, 10, 4	82, 12, 8
Keypad connector	■	❑	❑

■—Yes ❑—No
N/A—Not applicable: The product does not have this feature.

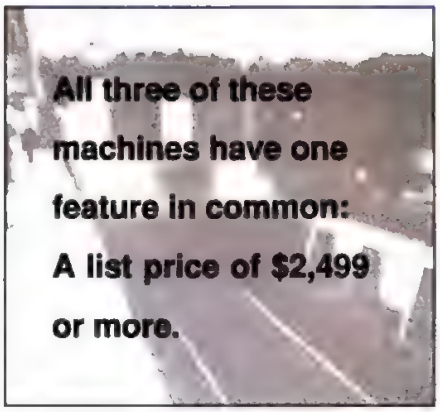
CONTINUES

less weight. In addition to smaller batteries, these notebooks require smaller transformers and other power supply components. All this helps trim excess weight.

Better yet, 8086-based designs are cheaper to build since they typically use lower-cost components. Combined with the lower weight and longer battery life, the cost savings can be significant.

SMALLER YET

There are some alternatives that are even smaller: Pocket or palmtop computers. These include the Casio BOSS, the Sharp Wizard, the Poqet PC, and the Atari Portfolio. With varying degrees of DOS compatibility, these diminutive miracles can be used for a variety of helpful tasks, from maintaining name and address lists to running spreadsheets. But they all have smaller-than-standard keyboards, and few people find them comfortable enough for tasks that require lots of typing. The larger 8086-class notebooks still have a decided edge in this area.



Two of the three machines reviewed here represent a move to increase the storage capacities and flexibility of this laptop class. Both the Compaq and the Toshiba include floppy and hard disk drives as standard equipment. The Psion takes a different tack, going for minimum weight and maximum battery life by using flash EPROM packs for storage instead of mechanical disks.

All three of these machines have one important feature in common: A list price of $2,499 or more. Though this pricing puts them in a range well above that of most 8086-class machines of the past, their respective manufacturers point to extra capacity or other significant features to justify the cost. However, such prices approach those of many competing 286 designs. Take a look for yourself and see how the scales tip for these low-power notebooks.

8086-BASED PORTABLES: SUMMARY OF FEATURES

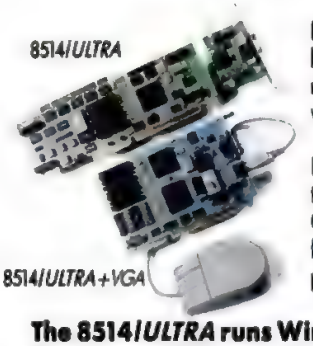
Products listed in alphabetical order by company name

	Compaq LTE	Psion MC600	Toshiba T1000LE
SOFTWARE			
DOS	4.01 ($150)	3.22	3.3 (4.01, $120)
Disk caching software	Compaq	None	None
Expanded memory manager	CEMM	None	None
Other	None	DOS Editor, LapLink III	None
COMMUNICATIONS			
Internal modem	2,400 bps ($449)	2,400 bps ($400)	2,400 bps ($349)
V.42bis/MNP 5	Optional/optional ($599)	❑ / ❑	Optional/optional ($449)
Modem options	None	None	None
PHYSICAL FEATURES			
Power supply (watts)	24	16	N/A
Dual voltage	■	❑	■
Power-on/reset switch	Top/none	Top/top	Top/side
BATTERY			
Claimed battery life (hours)	3.5	20	3
Charge time (hours) with unit on, off	8–10, 1.5	12, 14–15	8, 4
Battery voltage, Amp-hours	4.8V, 5.0 Ah	12V, 0.6 Ah	7.2V, 2.2 Ah
Shutdown:			
Display/disk	■ / ■	■ / N/A	■ / ■
System/peripherals	■ / ■	■ / ■	❑ / ■
Transformer weight (pounds)	1.4	0.9	1.4
Transformer size (inches)	2.2 x 5.2 x 3.2	1.9 x 2.6 x 2.2	5.8 x 3 x 1.8
MISCELLANEOUS			
Car battery adapter available	■	❑	■
Coprocessor	None	None	None
Setup in ROM/Password in ROM	■ / ■	■ / ■	Partial/❑
Warranty	1 year	1 year	1 year
Service	Dealer	Manufacturer	Manufacturer or dealer
FCC certification class	B	B	B
FCC identification number	CNT75M5396	ILPDC600A	CJ6UK376

■—Yes ❑—No
N/A—Not applicable: The product does not have this feature.

ENDS

A list of all the things you can do waiting for ATI's new 8514/*ULTRA* to open Windows.



Don't blink now! Keep both eyes open or you may miss the revolutionary new way of looking at Windows.†

For openers, nothing matches the 8514/*ULTRA*† for speed. Other cards claim they're fastest, but don't let them pull the wool over your eyes.

The 8514/*ULTRA* runs Windows 24 times faster than Super-VGA cards*. And five times faster than TI 34010† cards*. It has the power to deliver 386 graphics performance on a 286 machine, and then some. So you don't have to spend big bucks to upgrade your system, when the 8514/*ULTRA* does more for a lot less.

Like nothing you've seen before.
The 8514/*ULTRA* delivers high resolution and eye-popping detail. With 70Hz non-interlaced display, flicker-free graphics come alive in brilliant 1024x768 resolution, and up to 256 colors.

True laser print for the screen.
Everyone talks about WYSIWYG. Only the 8514/*ULTRA* delivers it. ATI's remarkable CRYSTAL Fonts† scale and display Windows text in true laser quality – right on the screen. That's equivalent to 3200x2400 resolution! So even type as tiny as 6-point is clearly legible. Don't waste time and money printing and proofing page-after-page. The 8514/*ULTRA* lets you do it accurately on-screen.

Plus, it's register compatible with IBM's 8514/A† and software compatible with XGA† cards. And with our innovative "Flippy" design, you get Micro Channel† and AT-bus support on a single card.

The 8514/*ULTRA* is also available with an integrated VGA*WONDER*+† controller and Microsoft† compatible bus mouse.

Why not let the 8514/*ULTRA* open new Windows of productivity – in the blink of an eye.

Priced from $599.**

For more information, contact your supplier, or:

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*Average speed based on PC Magazines's WINBENCH V1.1 Windows benchmark test. Results available upon request. **Suggested retail price for 512K model. 1MB versions also available. Dealers may sell for less.

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CIRCLE 540 ON READER SERVICE CARD

COMPAQ COMPUTER CORP.

Compaq LTE

by Alfred Poor

True to the Compaq tradition, the LTE, Compaq's notebook-class contender, quickly became a best-seller when it made its debut. By now, however, its cutting edge has been blunted by two disadvantages: an 8.5-pound weight (including the 1.6-pound charger) that stretches the upper limit of the notebook class, and a list price that breaks $3,000 for *PC Magazine*'s standard 1MB configuration.

FACT FILE

Compaq LTE
Compaq Computer Corp., 20555 SH 249, Houston, TX 77070; 800-231-0900, 713-370-0670.
List Price: With 640K RAM, 1.44MB floppy disk drive, CGA LCD, $1,999; with 1MB RAM, 20MB hard disk, $3,048.
Options: 20MB hard disk, $799; 2,400-bps modem, $449; 2,400-bps enhanced modem, $599; external fast charger/AC adapter, $199; extra battery pack, $129; 360K, 1.2MB, or 1.44MB external floppy disk drive, $275; external storage module, $349; 60MB tape drive, $799; 60MB tape cartridge; $50; external numeric keypad, $119; serial interface board, $149; carrying case, $89.
In Short: A portable PC sales leader, the 7-pound Compaq LTE appears dated when compared with more powerful systems at comparable prices. Construction is as sturdy as ever, and the battery lasts more than 5 hours. However, a squashed CGA display mars the well-lit screen, and keyboard layout is awkward.

CIRCLE 403 ON READER SERVICE CARD

In this case, however, the extra heft does equate to good performance. Based on an 80C86 processor running at 9.54 MHz, the LTE turns in CPU and memory times that are about as fast as any in its class. With a floppy disk drive, the model comes with a $1,999 sticker price, but adding the 20MB Conner 3.5-inch hard disk drive boosts the base price to $2,798. The computer comes with 640K RAM, and when you expand it to its maximum 1MB capacity (the standard we specified for our evaluation unit), the price tops out at $3,048.

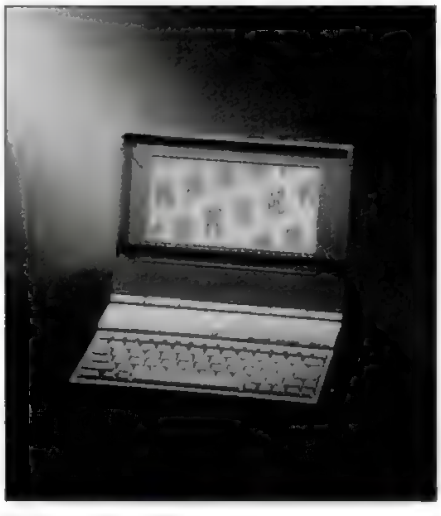
Because Compaq products have an excellent reputation for quality, the premium price and a little extra weight may not be enough to make you dismiss the LTE, with its true 8.5- by 11-inch notebook dimensions. But a closer look at the machine's features do little to enhance its attractiveness even to the least frugal of buyers.

For example, while other notebooks use full-size keycaps for all the keys on their keyboards, the Compaq falls short in this regard. The Ctrl, Alt, arrow, and function keys are all smaller than normal. The backslash key is as tall as the regular keys but not as wide, which makes it look and feel strange.

Worse yet, the arrow keys are arranged in an L-shaped pattern with Left and Right next to each other, and Up and Down above and below each other—as unintuitive an arrangement as is currently found on laptops. Although you can adjust to almost any keyboard over time, it seems that in an effort to keep the computer's width to a minimum, Compaq has come up with an arrangement that will confound users who have to switch to and from a standard desktop keyboard.

The LTE's CGA display leaves much to be desired as well. Although it has a good backlight, the screen, which measures 7.7 inches wide by 3.6 inches high, has a squashed aspect ratio. Instead of the typical 1.33 proportion of width to height, the LTE display is more than twice as wide as it is tall. This was an acceptable limitation in early generations of notebook computers but looks decidedly dated in today's market.

There are other problems. The computer does have a resume mode, but you can't turn it off simply by using the on/off switch. If you should accidentally close the cover without turning off the computer, the machine provides no warning, nor does it turn itself off. The LTE will go into its standby mode after 10 minutes of inactivity.



Compaq LTE, $3,048.

The LTE was a triumph a few years ago, but it has been outstripped by the competition. There are 8086-class designs that are lighter and friendlier, and there are 286 models from CompuAdd and Zeos, among others, with more power at a similar weight and price. This leaves the LTE in the awkward position of being most expensive in its class and least useful. You'll do best by looking elsewhere.

PSION INC.

Psion MC600

by Alfred Poor

The Psion MC600 is an unusual computer—both because of what comes standard, and what doesn't. The base-priced model, with its 2MB of peripheral storage and a maximum of 640K RAM, lists for $2,995. But apart from DOS 3.22, *LapLink III*, one parallel and one serial port, one open port, and some documentation, almost everything about the MC600 is an extra-cost option.

Most notably, batteries are not included. Unlike the other laptops in our 8086-class section, which come equipped with proprietary rechargable batteries, the Psion machine requires only eight AA-size alkaline batteries. These will power the MC600 for nearly 13 hours, though if you leave the computer in its resume mode to preserve the contents of system RAM between computing sessions, you will need to replace these batteries on a weekly basis.

Rechargeable nickel cadmium battery packs, available in two different power ratings, cost $50 to $70. In order to recharge them—or to run directly on AC power—you'll need a $30 AC adapter, though you may well be able to find something at your local Radio Shack that does the same job for a fraction of that price.

Once you get the juice flowing, you'll notice the screen. It's dark. There's no backlight for this 8.2- by 5.1-inch CGA LCD. The screen's contrast control is operated via the keyboard, and we had to experiment a bit to find the right key combination in order to reverse the adjustment. A standard thumbwheel control may be low-tech, but it's easier to operate.

The same could be said, perhaps, of the

If you don't see what

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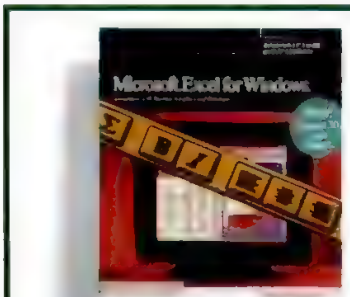

Microsoft ... NCP
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More powerful graphics, dynamic linking between other Windows programs, and additional help and file compatibility for anyone familiar with Lotus 1-2-3, makes this a must for any serious Windows user. . $329.

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8114 ▣Backup 6.0 . . . . . 59.

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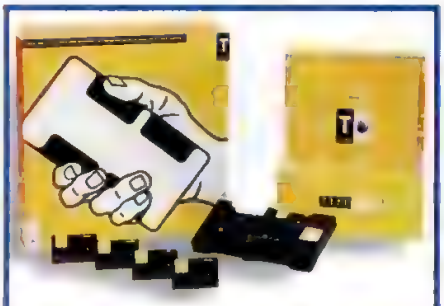

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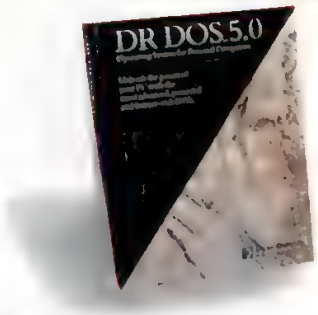

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3804 □WordPerfect 5.1..... 265.
6685 ◙DrawPerfect 1.1..... 279.

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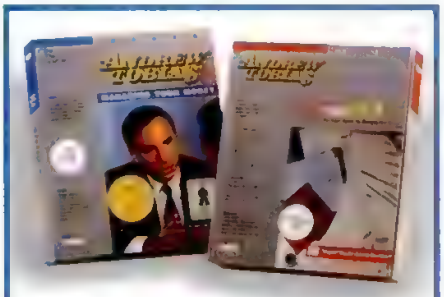

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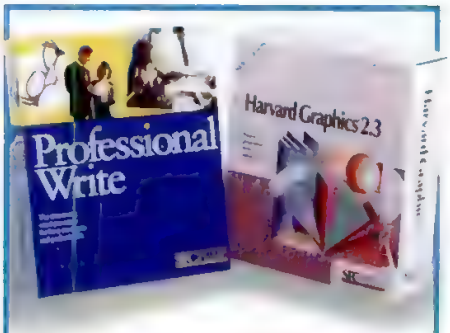

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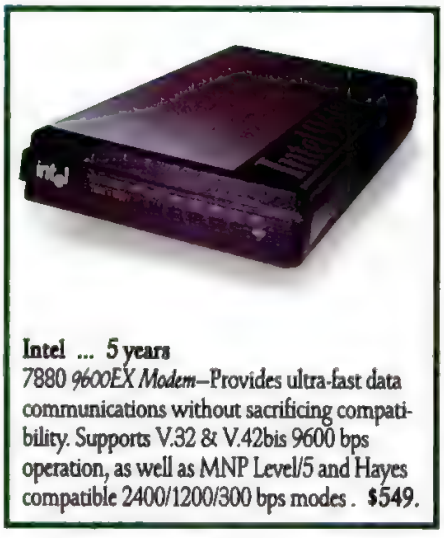

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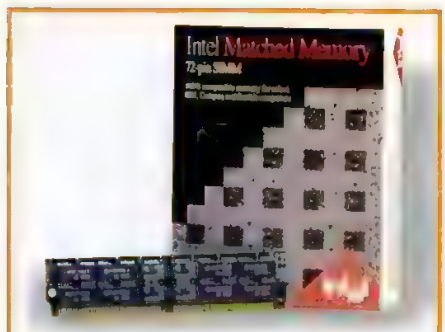

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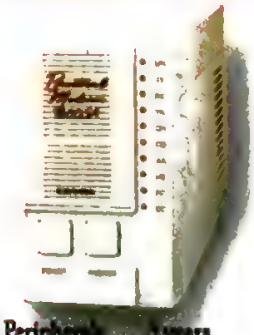

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8876	CP3104 100 Meg IDE HD *(25 ms)*	549.

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5116	Bernoulli II 44 Meg Internal	995.
7551	Bernoulli II Transportable 44 Meg	997.
5113	44 Meg Cartridge Tripak *(5¼")*	249.
2500	PC2B Controller	229.

Mountain Computer ... 2 years

2917	40-60 Meg Internal Tape Drive	259.
5500	80-152M Int. Tape Drive	629.
5190	DC2000 Pre-formatted Cartridges ea.	35.
6153	DC2120 Tape Cartridge *(5 pack)*	149.

Pacific Rim ... 1 year

5010	1.2 Meg External *(for PS/2's)*	215.
6602	1.44 Meg External *(for PC/XT/AT)*	239.

Plus Development ... 2 years

6424	Hardcard II 80 Meg *(19 ms)*	599.
8304	Hardcard II XL 50 Meg *(9 ms)*	399.
8287	Hardcard II XL 105 Meg *(9 ms)*	689.

Seagate ... 1 year

2285	20 Meg Int. Hard Drive ST225 *(w/controller and cables, 65 ms)*	255.
2286	30 Meg Int. Hard Drive ST238R *(w/controller and cables, 65 ms)*	269.
4554	40 Meg Int. HD ST251-1 (28 ms)	329.

TEAC ... 1 year

4670	1.44 Meg Drive for PC/XT *(3½")*	$89.
4326	1.44 Meg Drive for AT *(3½")* with Bastech software	109.
4951	720k Drive for PC/XT *(3½")*	75.
6951	1.2 Meg Drive for AT *(5¼")*	99.

DISKS/MEDIA

Maxell ... lifetime

2789	5¼" MD2-D 360k Disks *(Qty. 10)*	10.
2792	3½" DS/DD 720k Diskettes *(Qty. 10)*	13.
2793	3½" DS/HD 1.44Mb Diskettes *(Qty. 10)*	21.

Canon ... 1 year

7894 BJ-10e BubbleJet Printer–Light weight, excellent print quality and a great price make this 4.6 lb. printer a winner. Choice of black or white. Optional sheet feeder . . . . . $349.

TIMESLIPS ... NCP

2987 ☐ Timeslips III 4.0–Know exactly who owes you what with this time and expense billing system. Perfect for service professionals (accountants, lawyers, etc.) who need to track and bill their time . . . . . $195.

Sony ... lifetime

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3297	3½" DS/DD 720k Diskettes *(Qty. 10)*	12.
3298	3½" DS/HD 1.44Mb Diskettes *(Qty. 10)*	19.
6148	3½" DS/DD *(3 Pack)*	29.
6375	3½" DS/HD *(3 Pack)*	49.
8185	QD 2040 Tape Cartridge	19.
6712	QD 600A Tape Cartridge	27.
6715	QD 6150 Tape Cartridge	27.

3M ... lifetime

3943	DC 2000 Tape Cartridge	20.
6065	DC 2080 Tape Cartridge	25.
3944	DC 600 Tape Cartridge	29.
5679	DC 6150 Tape Cartridge	29.

MEMORY

6556	256k DRAM *(100 ns, set of 9)*	call
5510	1 Meg x 9 SIMMs *(80 nanosecond)*	call
5746	1 Meg Chips *(80 ns, set of 9)*	call
7813	256k x 4 Chips	call

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Hayes ... 2 years

8049 JT Fax 9600B–Good, solid fax board from the company who wrote the book on communications. TSR fax software, print capture, and one-step convert and send are just a few of the features . . . . . $379.

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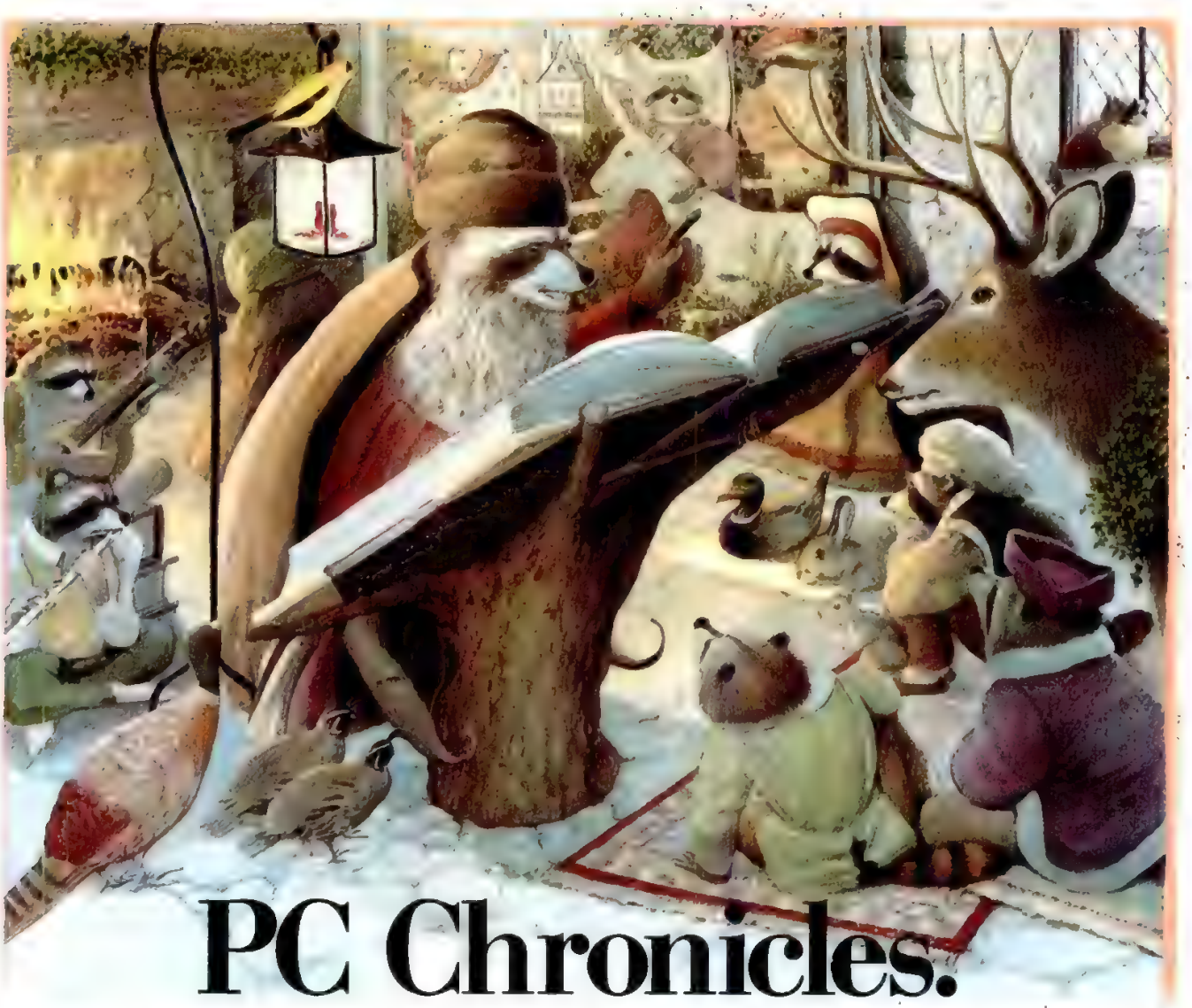
Alaska and outside Continental US:

- Call 603/446-7721 for information.



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FACT FILE

Psion MC600
Psion Inc., 118 Echo Lake Rd., Watertown, CT 06795; 617-237-8538.
List Price: With 640K RAM, 2MB solid-state storage, CGA LCD, one parallel and serial port, one open port, DOS 3.22, *LapLink III*, $2,995.
Options: Flash EPROM storage modules: 128K, $150; 256K, $250; 512K, $400. 2,400-bps internal modem, $400; external 3.5-inch 1.44MB floppy disk drive, $400; AC adapter, $30; 600-mAh nickel cadmium battery, $50; 1-Ah nickel cadmium battery, $70.
In Short: Psion tries to deliver high tech in a 5.2-pound system that uses flash EPROM modules for storage and alkaline batteries for power, but the result is low performance and limited memory. The extended battery life is deceptive because there's no screen illumination to sap the power. À la carte pricing further detracts from the MC600's overall value.

CIRCLE 404 ON READER SERVICE CARD

MC600's storage medium. This notebook takes an unusual and complex modular approach to data storage. The MC600 has four slots for EPROM cartridges, each of which can accommodate up to 512K of storage. These modules— at $400 for the 512K flash EPROM module, for example—can be somewhat expensive compared with the dollar or two cost of a 3.5-inch floppy disk that can hold nearly three times as much data.

And the solid-state storage devices have other problems beside their expense. Each module relies on a built-in battery to preserve its contents when it is removed from the computer. You'll have no warning when the battery is nearly discharged, and once the battery loses its juice, you lose your stored data. On the other hand, the flash EPROMs will maintain their contents for up to 10 years without any battery. However, they cannot reuse space

Psion MC600, $2,995.

BENCHMARK TESTS: 8086-BASED PORTABLES

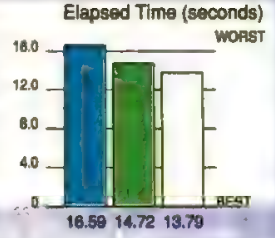
The classic Compaq LTE shows the best processor and memory speeds, while Toshiba's T1000LE fares best on disk access. Still, none stands out as a price/performance winner. You'll buy an 8086-class notebook for its light weight and low cost, not for its speed.

PC Labs tested three 80C86 laptops for this section: the Compaq LTE, the Psion MC600, and the Toshiba T1000LE, using PC Magazine Labs' Hardware Performance Tests, Release 5.6. In all cases, we left the buffers at their default values. We used no software disk caches when performing disk benchmark tests, and no RAM-resident programs were loaded for any tests. The margin of error for the processor, memory, and video benchmark tests is 0.05 seconds.

PROCESSOR AND MEMORY BENCHMARK TESTS

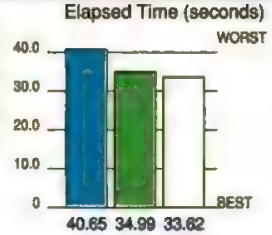
8088 Instruction Mix

The **8088 Instruction Mix** benchmark test times a series of tasks specific to the 8088 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.



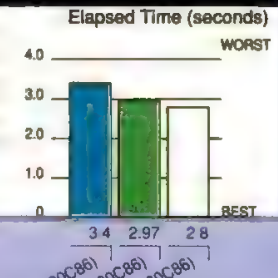
Floating-Point Calculation Without Coprocessor

The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.



Conventional Memory

The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.



N/A—Not applicable: The machine did not complete these tests.

All of its awkwardness might be acceptable if the Psion MC600 were tiny or powerful. But it is neither.

taken up by deleted files. You have to copy the data to another storage device, then reformat the EPROM cartridge, then copy the data back again in order to regain that lost space. These cartridges are handy if you're using them just for programs, but not if you're storing a lot of data.

All of this awkwardness might be acceptable if the machine were tiny—a featherweight—or particularly powerful, but it is neither. The unit is slightly larger than a notebook, with dimensions of 1.9 by 12.4 by 8.9 inches (HWD). With a full load of alkaline batteries, the MC600 weighs 5.2 pounds, only slightly lighter than the competition. Add the AC adapter and you top 6 pounds in all. Moreover, with its 7.68-MHz 80C86 CPU, the Psion is slower than competing machines—a fact borne out in our testing, where the Psion machine showed slower performance than the other machines in its class and was unable to run our DOS File Access benchmark tests.

There is no doubt that the MC600 represents some clever engineering and includes some interesting features. But the base unit is expensive, and by the time you add the features to make it comparable with the floppy-based machines it must compete with, you end up with similar storage capacity and slower performance in a machine that is at best a pound lighter and more than twice as expensive.

TOSHIBA AMERICA INFORMATION SYSTEMS INC.

Toshiba T1000LE

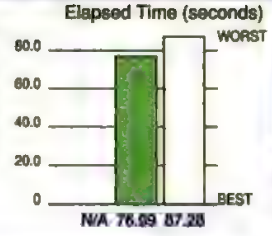
by Alfred Poor

For those of you who have been waiting, Toshiba just dropped the third shoe. The release of its $2,499 T1000LE rounds out Toshiba's line of new-generation 80C86 notebook computers.

DISK BENCHMARK TESTS

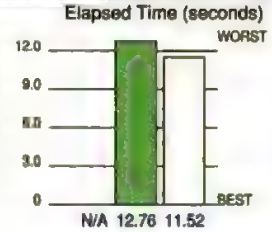
DOS File Access (Small Records)

The DOS File Access (Small Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.



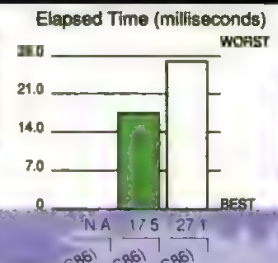
DOS File Access (Large Records)

The DOS File Access (Large Records) benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.



BIOS Disk Seek

The BIOS Disk Seek benchmark test measures mechanical track-to-track disk drive access times. Fast times are helpful with programs such as databases, which often store and must later find data in many separate places on a drive.

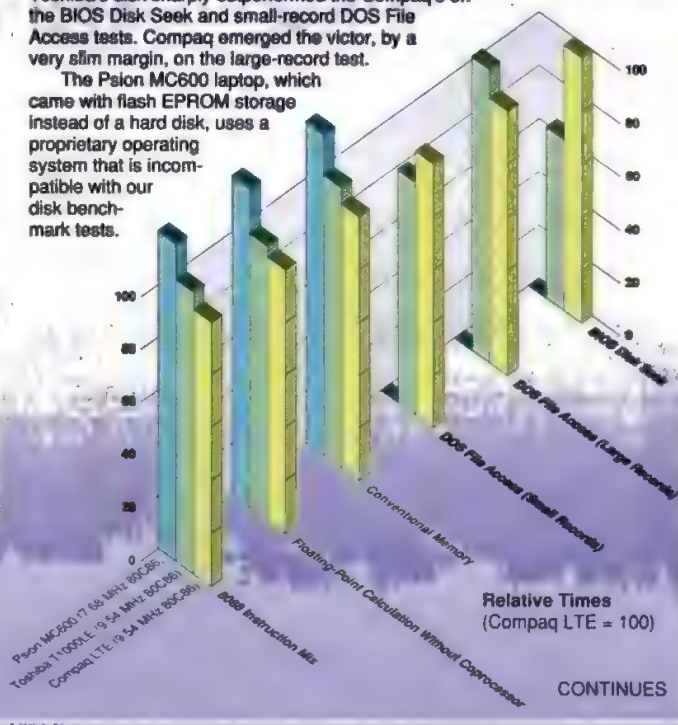


PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

The 9.54-MHz Compaq LTE dominates all three processor and memory tests, beating the 9.54-MHz Toshiba T1000LE by roughly a second on each processor test. A 7.68-MHz processor speed, meanwhile accounts for the Psion MC600's poor showing. The Psion did compare favorably with other systems running at that speed.

Toshiba beat Compaq on the disk test suite, as the T1000LE uses a faster hard disk. Both disks are 20MB Conner IDE models, but Toshiba chose one with a 23-millisecond rating, while Compaq used a 29-ms. model. The Toshiba's disk sharply outperformed the Compaq's on the BIOS Disk Seek and small-record DOS File Access tests. Compaq emerged the victor, by a very slim margin, on the large-record test.

The Psion MC600 laptop, which came with flash EPROM storage instead of a hard disk, uses a proprietary operating system that is incompatible with our disk benchmark tests.



CONTINUES

The Toshiba T1000LE follows the same excellent design established by its smaller-storage siblings.

The T1000LE shares the same design as its older siblings, the T1000SE and the T1000XE. Like the SE, the T1000LE includes 1MB of RAM standard (upgradable to 9MB), an auto-resume mode, a big, sharp, sidelit CGA liquid crystal display, and a 1.44MB floppy disk drive. Like the XE, the T1000LE holds a 20MB hard disk.

The T1000LE has managed to stay slim despite its added storage—though at 2.0 by 12.2 by 9.8 inches (HWD), it's still slightly larger than a notebook. Even with an optional modem installed in our evaluation unit, however, the machine weighed 6.6 pounds—just ounces heavier than an SE without a modem.

To meet the added power requirements of the hard and floppy disk drives, the LE's new removable battery packs are rated at 2.2 Amp-hours instead of the older machines' 1.7-Ah rating—nearly a 30 percent increase. Thanks to a bit of ingenious design, you can add even more battery life, should you need it, by plugging an extra battery into the space other-

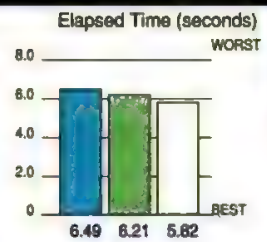
Toshiba T1000LE, $2,499.

BENCHMARK TESTS: 8086-BASED PORTABLES

VIDEO BENCHMARK TESTS

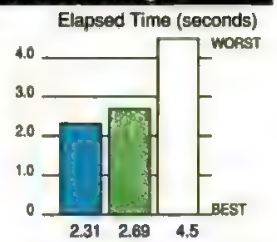
Direct to Screen

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.



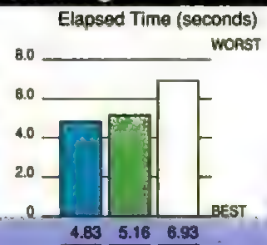
Video BIOS Routine Without Scrolling

The **Video BIOS Routine Without Scrolling** benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.



Video BIOS Routine with Scrolling

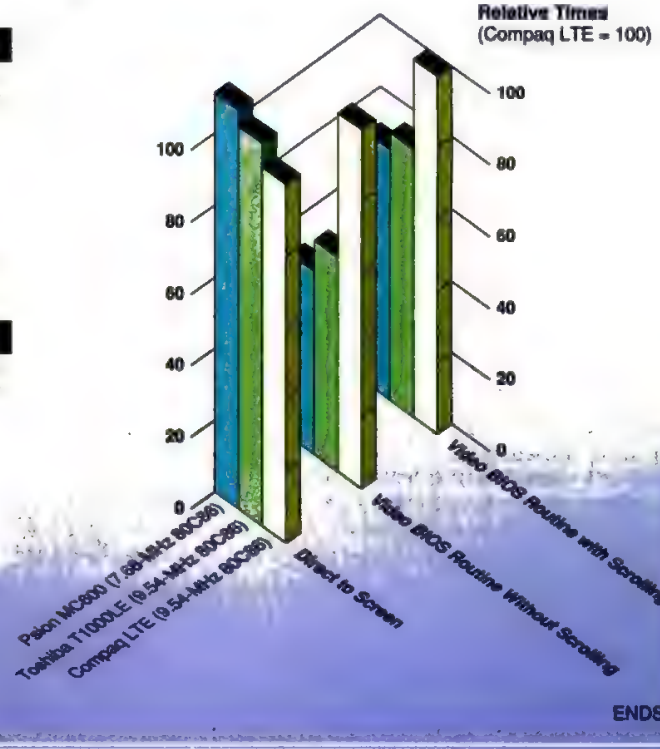
The **Video BIOS Routine with Scrolling** benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.



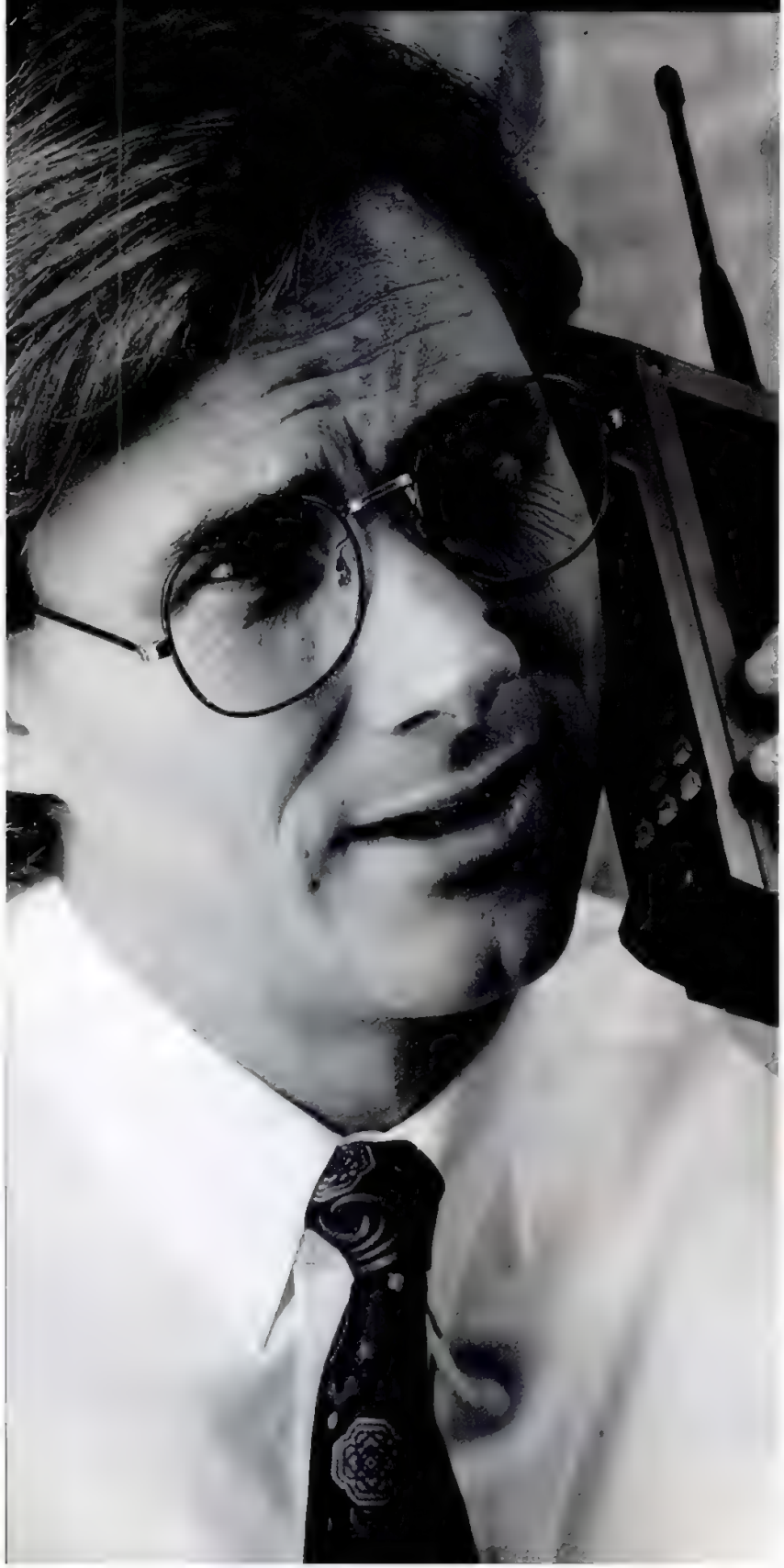
Psion MC600 (7.68-MHz 80C86)
Toshiba T1000LE (9.54-MHz 80C86)
Compaq LTE (9.54-MHz 80C86)

VIDEO BENCHMARK TESTS: COMPOSITE VIEW

All three laptops have a CGA display and an 8-bit video interface integrated on the motherboard; none of them can take advantage of video shadowing. The Compaq LTE placed first on the Direct to Screen test, with the Psion lagging in the rear. Those standings were reversed on the Video BIOS Routine tests, where the Psion took top honors. Neither shining nor faltering, the Toshiba placed respectably on all three video tests.



"Only good accounting software can bring our network and business up to speed."



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"So?"

"Doing a little 'networking' at the game tonight."

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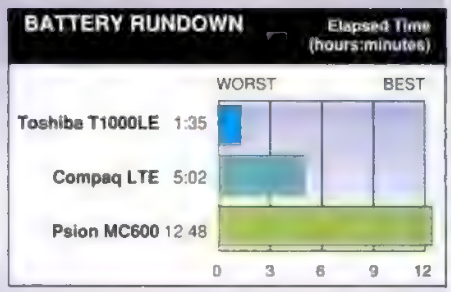
*Contact your local Sears Business Centers for details.

PERFORMANCE TESTS: 8086-BASED PORTABLES

The **Battery Rundown** performance test involves teletyping five screens of text to the laptop computer's display and writing a 15K file to the hard disk, once every minute until the battery runs out of power. All power conservation techniques are disabled.

While the Psion MC600 topped the performance chart in terms of battery life, this unit used alkaline batteries rather than the nickel cadmium batteries used by the other manufacturers represented here. The manufacturer claims a battery life of 20 hours for this unit, but under PC Magazine Labs' testing the system's eight AA batteries lasted only 12 hours 48 minutes.

The Compaq LTE's 5.0 Amp-hour nickel cadmium batteries turned in a performance of 5 hours 2 minutes, outlasting the manufacturer's claimed battery life by 1 hour 32 minutes. The Toshiba T1000LE, which used 2.2-Ah nickel cadmium batteries, showed a rundown time of 1 hour 35 minutes—far less than the 3 hours claimed by Toshiba.



wise used by the machine's optional internal modem.

The Toshiba laptop keyboard is well known for its logical layout and ease of use. The cursor arrow keys are conveniently located in an "inverted T" pattern in the lower-right corner; the layout of these four keys is the same as on the cursor pad of a 101-key desktop keyboard. All the keys are the standard width, though the Esc key and 12 function keys across the top are only half as tall as standard keys. The keyboard contains the same special keys as other Toshiba laptops, such as the embedded numeric keypad and the PopUp key, which displays a gauge for remaining battery power and lets you make basic changes to the system's power-save configuration.

Not everything is the same on the T1000LE as on the older models. The power switch is now placed above the keyboard, where it is protected when the cover is closed. In addition, the controls for screen brightness and contrast adjustments can now be found along the right edge of the screen, instead of along the side of the keyboard as they are on the Toshiba T1000SE.

In general, the Toshiba T1000LE follows the same excellent design established by its smaller-storage siblings. Unfortunately for the T1000LE, that may not be enough. With a list price of nearly $2,500 for the basic configuration, the street price will probably be between $1,700 and $1,800. Last year, that would have been an exciting price for an exciting product.

This year is different. There are 80286-based notebooks from CompuAdd, Texas Instruments, Zeos International, and others with similar storage and features that offer much better performance for a comparable price.

While it may be true that many people will be satisfied with 8086-class performance in a notebook computer, it is just as easy to assume that they will opt for 80286-class performance when the price and weight are closer than they've ever been before. ■

FACT FILE

Toshiba T1000LE
Toshiba American Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445.
List Price: With 1MB RAM, 20MB hard disk, 1.44MB floppy disk drive, CGA display, $2,499.
Options: Memory upgrade, $499 per MB; 2,400-bps internal modem, $349; 2,400-bps enhanced modem, $449; 360K external floppy disk drive, $499; 1.7-Ah battery pack, $79; 2.2-Ah battery pack, $129; battery pack for modem slot, $79; battery recharger with AC adapter, $349; Desk Station II, $1,199; nylon carrying case, $99; leather carrying case, $129.
In Short: Equipped with both a hard disk and a floppy disk drive, Toshiba's latest 80C86-based portable shows the same excellent design and keyboard as its previous models. Compact and lightweight, the system sports a big, sharp CGA display. But the price is still high in view of its 8086 processor.

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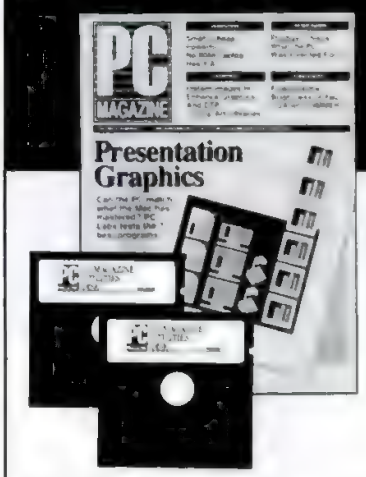

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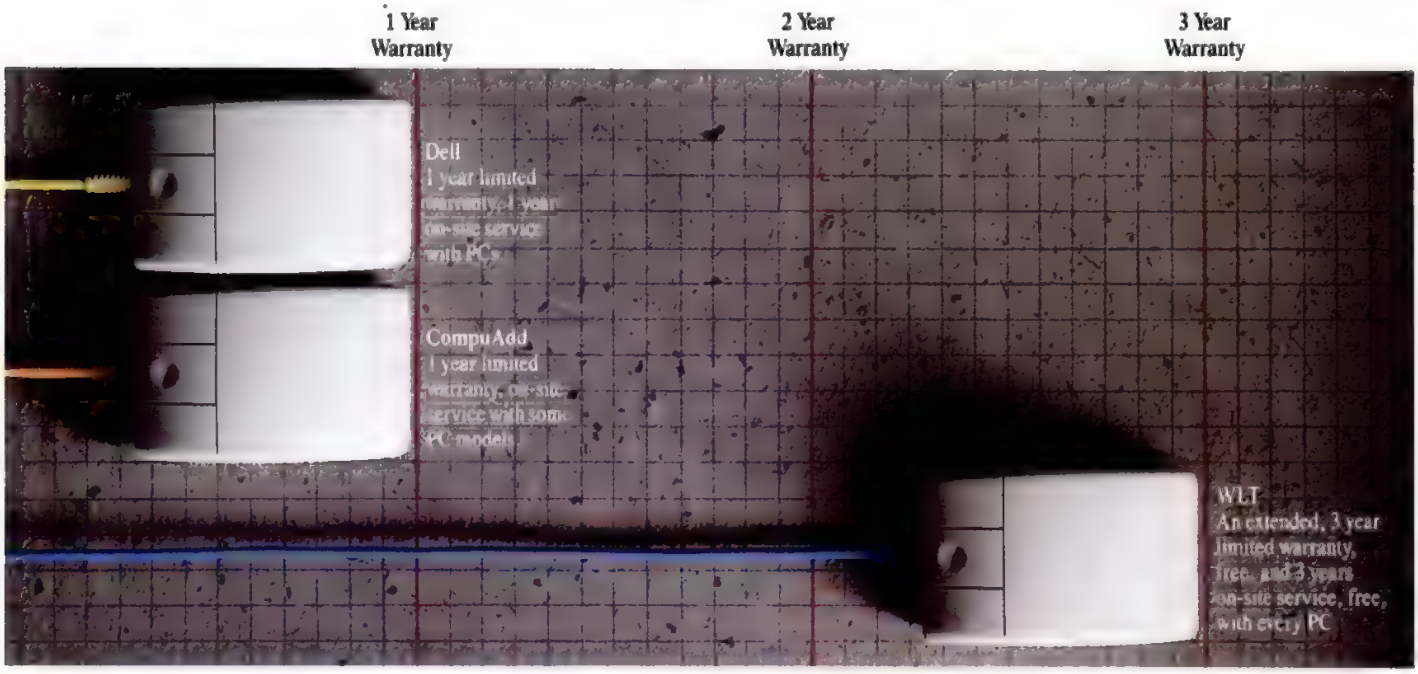

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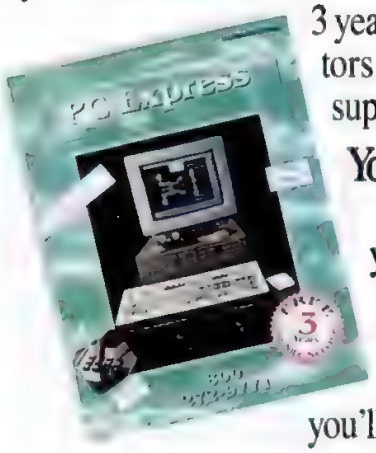

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486-Based Portables

PHOTOGRAPHY: JOHN WILKES

With the exception of the IBM P75, no 80486-based portable has yet received its crucial FCC Class B certification, and therefore none but the P75 can be offered for sale.

by Winn L. Rosch

Imagine all the power of today's fastest 80486-based desktop PCs compressed into a package you can tote under your arm—or at least lift above your knees. Think of the implications: workstation performance wherever you want it; a machine you can move between home and office without compromises; the ultimate strategy for getting graphical, mathematical, and analytical answers anywhere in the world.

If you're a real power user, you're probably reaching for your checkbook already, though you'd be better off applying for a second mortgage. Right now you have your choice of only one portable 486-based machine: IBM's $15,990 PS/2 Model P75 486.

But wait a minute. You've probably seen dozens of ads for 486 portables, most of them at more realistic prices. Unfortunately, you cannot legally buy them, because among all the 486-based portables advertised, only one has Class B certification from the Federal Communications Commission, and that one is the IBM.

For most 486-based portable computer makers, today is too soon.

If you're feeling confused, you're in good company. Besides the IBM, we rounded up a dozen 486-based self-contained PCs topped with handles, including the Bitwise 486-33, Dataworld 486-25, Diamond Technology Gas Plasma PC3, Dolch P.A.C. 486-25 and 486-33, International Instrumentation 486-33, Micro Express Regal 486, Micro Telesis 486, National Micro Systems 486-25, Panther 486/25, Tangent 486/33, and Wedge 486. Their prices range from $3,699 to over $21,280, the most expensive unit being a 33-MHz machine with a color thin-film-transistor LCD screen. All are AC-operated units, because the power requirements of the 486 microprocessor with enough memory to be useful would suck any totable battery dry in a few minutes.

Any one of these 486-based portable PCs has the potential of giving you full desktop speed that you could take on the road, if not in the air. They'll let you race through scientific calculations on-site or even set up a temporary network. From the standpoint of power, the 12 machines that PC Magazine Labs tested as a basis for comparison demonstrated performance only a hair's breadth below the fastest desktop 486s. (A composite of their performance is included in our benchmark test report.)

Nevertheless, for most portable computer makers, today is too soon. They have yet to achieve FCC Class B certification, which is required for legal sales (and advertising) in this country. In fact, we found that except for IBM, none of the manufacturers had any record of having

BENCHMARK TESTS: 486-BASED PORTABLES

PC LABS

With average processor and memory benchmark test times—and below-average disk times—the IBM PS/2 Model P75 486 stands out for its video performance, thanks to its 32-bit bus-mastering XGA.

The **80486 Instruction Mix** benchmark test times a series of tasks specific to the 80486 chip. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

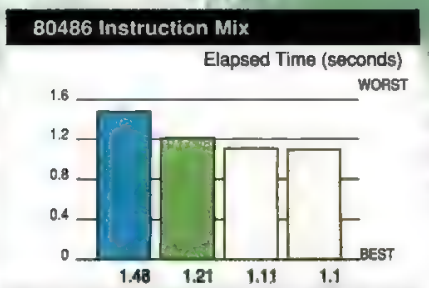
The **Floating-Point Calculation Without Coprocessor** benchmark test sets up a floating-point emulation program in RAM and then exercises the processor and tests RAM access speeds during floating-point calculations.

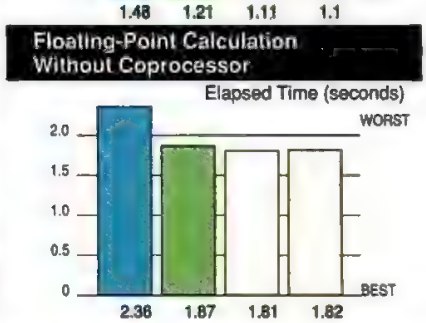
The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at slower access speeds.

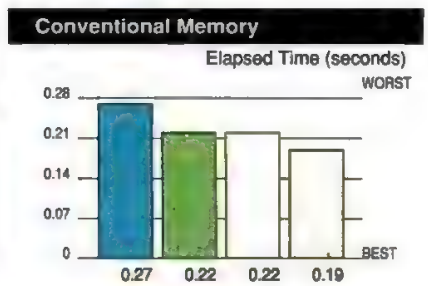
The **DOS File Access (Small Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. The test is performed without software disk caching. Fast times are advantageous for programs that work with many short segments of data.

The **DOS File Access (Large Records)** benchmark test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. This test minimizes the effect of small hardware caches on disk subsystem performance. It is performed without software disk caching. Fast times are advantageous when large files are loaded.

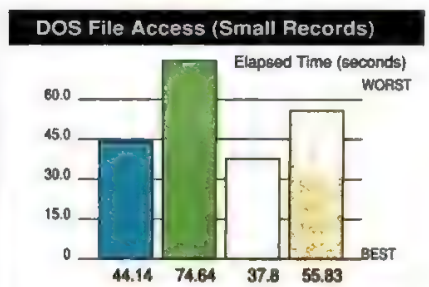
PROCESSOR AND MEMORY BENCHMARK TESTS

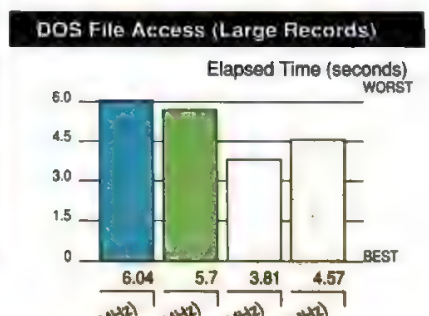






DISK BENCHMARK TESTS





* Reported for comparison.

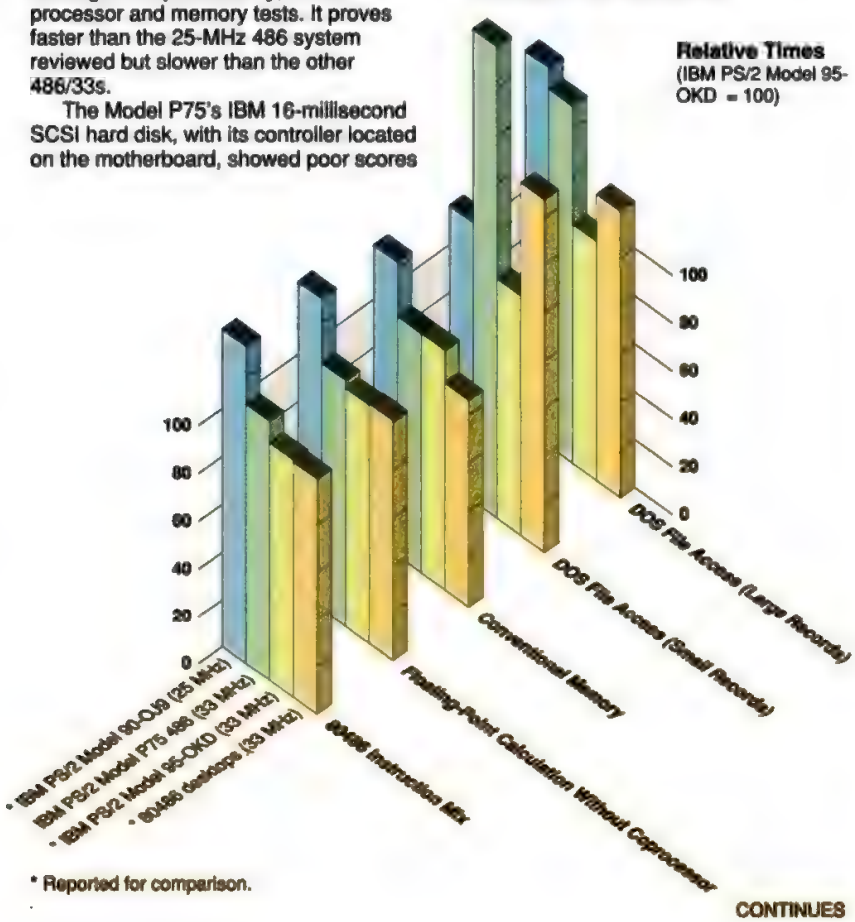
For this issue we used PC Magazine Labs' Hardware Performance Tests, Release 5.6, with video and system shadowing enabled wherever possible, and we left the buffers at their default values. We used no software disk caches when performing disk benchmark tests, and no RAM-resident programs were loaded for any tests. We are not reporting any times for our BIOS Disk Seek test because the one machine we reviewed uses a SCSI hard disk, and this disk technology is incompatible with the test. The margin of error for the processor, memory, and video benchmark tests is 0.05 seconds.

PROCESSOR, MEMORY, AND DISK BENCHMARK TESTS: COMPOSITE VIEW

PC Magazine Labs tested all 13 80486-based portables we originally received for this project. But only the IBM PS/2 Model P75 486 has an FCC Class B rating, which is required for all portable computers legally sold in this country. The scores for 33-MHz 486 desktop systems are an average of the thirty machines we reviewed recently ("33-MHz 486 PCs: Maximum Performance," *PC Magazine*, February 12, 1991).

IBM's Model P75 performs as expected, although not spectacularly, on the processor and memory tests. It proves faster than the 25-MHz 486 system reviewed but slower than the other 486/33s.

The Model P75's IBM 16-millisecond SCSI hard disk, with its controller located on the motherboard, showed poor scores on the DOS File Access tests; this is common with most SCSI hard disks we have tested, as SCSI controllers incur overhead in translating physical addresses (normally generated to find information on the hard disk) to logical addresses (which are necessary to communicate across the SCSI drives). The better showing of the IBM PS/2 Model 95's SCSI drive is due to having a 32-bit caching disk controller, as opposed to the 16-bit noncaching disk controller in the Model P75.



* Reported for comparison.

CONTINUES

applied for Class B certification for the 486-based hardware. At press time, only Dataworld claimed to have begun the procedure.

FCC PRIMER

The FCC rules regarding radio-frequency emissions from computers can be confusing, particularly if you don't have a magnifying glass for the fine print and a Zen-like appreciation of apparent paradoxes. All electronic devices that emit unintended radio-frequency signals (except a few that emit trivial amounts) are divided into two classes, A and B. Class A devices are for use as business equipment; Class B devices are approved for home use as well. Class A devices are allowed to create roughly ten times as much electronic interference as Class B. This means that if you run a Class A device at home, you're likely to disrupt your neighbor's electronic devices as well as your own.

The FCC states that all portable PCs must achieve certification as Class B devices.

As a general rule, all personal computers are required to meet the stringent standards for Class B certification. Some PCs, however, are so powerful or so expensive that the FCC believes their use in the home is extremely unlikely. Normally, a computer costing over $5,000 or equipped with a 486 microprocessor will fall into this category; 386 computers may also qualify, if they are sufficiently expensive.

In such a case, the vendor can market a Class A system for commercial or industrial use only. The FCC says the vendor is obligated to inform customers that the computer cannot be used in residential areas.

Here's the rub: The FCC states that all portable computers must achieve certification as Class B devices because their portable nature means they might be used in the home. The criteria for obtaining a waiver—$5,000 price or a powerful microprocessor—do not apply to portables. Indeed, an FCC representative noted that to his knowledge only a single waiver

for a portable computer had been granted within the past year. And that was for a machine that could be used only as a survey instrument connected to a seismograph—something most folks don't keep in their homes.

According to the FCC, none of the manufacturers who sent us 486-based portable computers (with the exception of IBM) had been sanctioned to sell their portables with Class A ratings. Although we have no doubt that many of those portables could meet Class A technical standards, we don't believe they can legally be marketed as Class A devices.

The point? Any portable PC you find wearing a Class A sticker or purporting to be a Class A device is almost certain to be erroneously labeled, either intentionally or because its maker did not understand the FCC rules. The FCC can stop the sale of such machines and fine the manufacturer.

Note that the FCC rules cover not only actual sales but the offering of equipment for sale, which includes advertising. A portable device that has not been verified as conforming to Class A requirements or certified as conforming to Class B requirements cannot even be advertised legally.

WE WILL REVIEW NO COMPUTER BEFORE ITS TIME

PC Magazine has chosen not to review portable computers that do not meet FCC requirements for sale in the United States. This is not an entirely new policy but rather a refinement. *PC Magazine* has already stressed the need for FCC ap-

BENCHMARK TESTS: 486-BASED PORTABLES

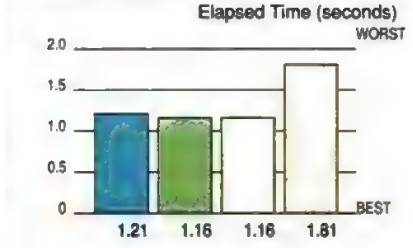
PC LABS

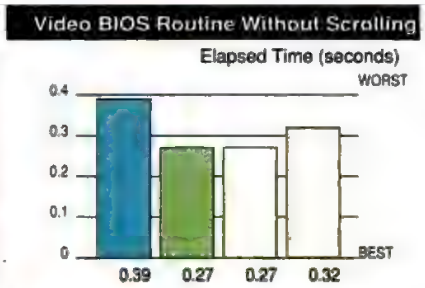
The Direct to Screen benchmark test indicates the speed of the video adapter memory. Good scores indicate that information can get to the screen quickly, particularly for programs that avoid the computer's BIOS and go directly to the screen.

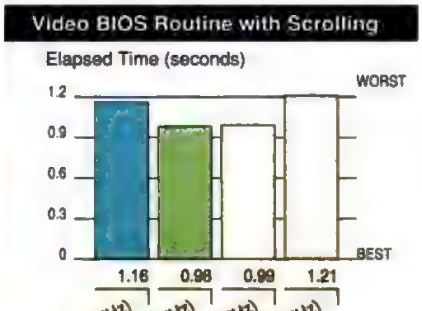
The Video BIOS Routine Without Scrolling benchmark test measures how quickly the BIOS on the video adapter writes text data to the screen. Fast video writing helps with programs that show full or partial screens of data without scrolling the screen.

The Video BIOS Routine with Scrolling benchmark test measures how fast the video adapter can scroll the screen, moving the display up one line at a time. Good performance is helpful for scrolling through word processing or spreadsheet files.

VIDEO BENCHMARK TESTS



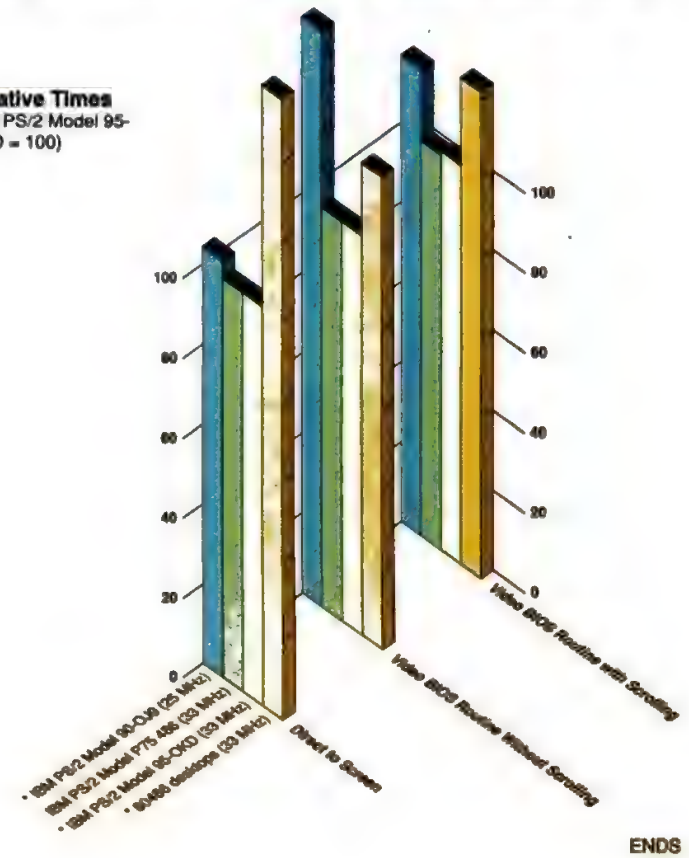




VIDEO BENCHMARK TEST: COMPOSITE VIEW

The IBM PS/2 Model P75 486 has an XGA gas plasma display, which uses a 32-bit bus-mastering interface. This explains why the machine surpassed all of the other systems whose times we report (except for the equally fast PS/2 Model 95, which is also a 33-MHz 486 that uses XGA).

Relative Times
(BM PS/2 Model 95-OKD = 100)



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proval of all products. We have reviewed Class A desktop computers—typically, 486s and 33-MHz 386s—because readers rely on our reviews in choosing products for their businesses as well as their homes.

We do not review Class A portable computers because legally there are no such things. We will review a computer only if the FCC has officially received the vendor's application for Class B certification by the time we go to press.

We confirm these applications by checking the FCC's Public Access Link, a computerized bulletin board service that allows anyone to follow a machine's progress in becoming certified. You can check with this service to find out whether a system has been certified Class B by dialing into the FCC Public Access Link at 301-725-1072. You will need the system's FCC ID number, supplied at the bottom of each story's features table.

A QUESTION OF QUALITY

Regardless of FCC certification, you probably wouldn't want to buy most of the 486 portables we received for review. The bulk of the machines we examined proved to be unacceptable in quality. Most were simply assemblies of 486-based system boards and a couple of disk drives in a lunchbox-style case. Each had the same detachable keyboard in front of a flat-panel screen, with drives accessible from the computer's side; they operate on AC power only and weigh between 20 and 25 pounds.

Many of these machines were housed in the same case, which was little more than a thin plastic shell; you wouldn't want to take it roving on the road. Press down on its top and it sags, and every component inside shifts ominously. In one system that used this case, we found the RAM cache board rattling loosely inside the cabinet. A screw that was supposed to hold it in place had stripped out of the plastic case.

The worst aspect of this case—and these machines—makes us doubt that computers packed inside it can be sold legally. The case provides no means of reducing radio-frequency emissions: no metal, not even emission-absorbing paint. When the case's construction was described to an FCC spokesman, he responded that any 486-based computer packed in it was not likely to pass muster as a Class A device, much less achieve the tougher Class B certification.

We were more favorably disposed toward the two cases that appear to have enough interference protection for a chance at Class B certification. The better of the two relied on an interior aluminum subchassis that made the package both solid and electrically sound. Although it lacked an adjustable screen, the keyboard and screen were acceptable. The other case was entirely plastic but did have a protective layer of interference-absorbing paint on the inside. Whether you can buy either of these will depend on the word from the FCC.

The 22-pound IBM PS/2 Model P75 486 is also of the lunchbox variety, though it is slightly wider and has a pop-out internal floppy disk drive. The difference between this and the other lunchboxes lies in IBM's attention to construction. IBM has gone to great lengths to trap interference before it escapes from the Model P75. For example, part of the case is metal-plated; other parts are lined with steel.

DOING IT YOURSELF

All is not bleak for the untethered power user, however. Even if you absolutely must have a 486-based portable and can't afford IBM's offering, you can legally create your own machine. Moreover, if you build your own 486 portable, you will probably guarantee yourself better workmanship than we found in many of the not-quite-commercial machines that we looked at.

The FCC rules specifically allow individuals to build their own computers without the need for verification or certification—provided that you make fewer than five machines and you do not offer them for sale. If you want a really powerful portable, pick up the telephone and order a strong case, a system board, and your favorite disk drives. You should be able to assemble a system that meets your needs in a couple of hours for a few thousand dollars.

And a final word of warning to computer kit manufacturers: Computer kits offered for sale must achieve the same certification or verification that completely assembled computers require. Bear in mind that 486-based portable computer kits will also need to be certified Class B.

Some people scoff at the idea of a 486-based portable. They see such systems solely as servers. But as the demand for microprocessor horsepower increases, we're certain that 486 portables will emerge as a viable (and legal) market. The steep price of the IBM Model P75 begs for competition. As soon as competitors can pass FCC muster, *PC Magazine* will be ready to help you make the right choice among them.

IBM CORP.

IBM Personal System/2 Model P75 486

by Winn L. Rosch

If there is a packaging hall of fame, whoever squeezed a 33-MHz 486 microprocessor, 16MB of RAM, a 400MB hard disk, four expansion slots, and XGA video into the IBM PS/2 Model P75 and still managed to get FCC Class B approval is certainly a candidate. This 12- by 18.5- by 6.3-inch machine is a marvel of compactness, not to mention the fastest computer you can buy with a handle on it. Of course, in the light of this $15,990 base price, you'd expect the Model P75 to earn one kind of award or another.

To call the 22-pound Model P75 a portable when notebook computers weigh 7 pounds or less may seem a leap of faith. But the Model P75 is not designed for the tray-table of your favorite airplane. It's an AC-only machine that's as luggable as a suitcase and as useful as any file server or stationary workstation.

The case is the key element in the Model P75's design. Although its outside is plastic, a metal subchassis lines the sides of the case, and metal plating inside the rear cover helps stop radio-frequency interference. The two major internal subassemblies—the bus bracket and hard disk bay—are made of stamped steel, while another stamped-steel subassembly protects the output port circuitry.

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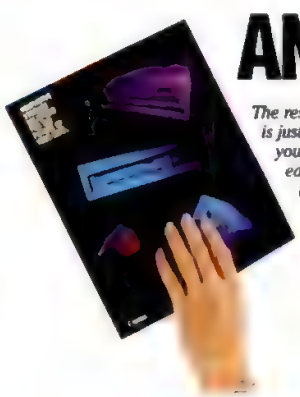

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CIRCLE 223 ON READER SERVICE CARD

three screws, five plastic latches, and a key lock. System and keyboard access can also be limited by a ROM-based password facility.

Pull off the back of the Model P75 and you'll see nearly the full height and width of the case lined with circuitry. There is no true system board, however. Instead, the electronics comprise several distinct units. This multiboard design will allow IBM to offer similar portables with different microprocessors and display circuitry without making major changes in the layout.

FACT FILE

IBM Personal System/2 Model P75 486
IBM Corp., Old Orchard Rd., Armonk, NY 10604; 800-426-2468, or call your local dealer.
List Price: With 8MB RAM, 8K RAM cache, 160MB hard disk, 1.44MB floppy disk drive, XGA display, one parallel and one serial port, mouse port, 101-key keyboard, $15,990.
Options: 2MB RAM upgrade, $565; 4MB RAM upgrade, $1,095; upgrade to 400MB hard disk, $2,900; 2,400-bps Micro Channel modem, $462; external 1.2MB floppy disk drive, $509; keyboard extension cable, $82; travel case, $299.
In Short: The only 486 portable legally available right now, the IBM PS/2 Model P75 is a 22-pound, attache-size Micro Channel machine. It contains a 10-inch gas plasma screen, XGA output, a bus-mastering SCSI system, and four MCA expansion slots (including two full-size 32-bit slots).

CIRCLE 408 ON READER SERVICE CARD

IBM PS/2 MODEL P75 486: SUMMARY OF FEATURES

Product name	**IBM Personal System/2 Model P75 486**
Price of standard configuration	$15,990
Distribution channel	Dealers, direct
TESTED CONFIGURATION	
Microprocessor	33-MHz 80486
Power supply type	AC only
Dimensions (HWD)	12.1 x 18.3 x 6.1 inches
Weight	22.1 pounds
Display subsystem	VGA
Display area (WxH)	8.3 x 6.4 inches
Display technology	Gas plasma
Motherboard manufacturer	IBM
Chip set manufacturer	IBM
BIOS version	IBM
Date	November 1990
Video shadowing/System shadowing	■ / ■
MEMORY	
RAM (minimum–maximum)	8MB–16MB
Installed RAM	8MB
RAM packaging	SIMM
Rated speed	70 ns.
Chip size	2Mb, 4Mb
Processor RAM cache installed	None
DISK DRIVE	
Hard disk capacity and size	160MB 3.5-inch
Manufacturer	IBM
Interface	SCSI
Average access time	16 ms.
Controller manufacturer	IBM
Controller location	Motherboard
Floppy disk drive capacity	1.44MB
EXPANSION BUS	
Bus speed	20 MHz
Expansion slots	2 16-bit, 2 32-bit

■—Yes ❑—No

The largest board, measuring almost 17 by 5.5 inches, holds most of the system essentials: the floppy disk control circuitry, SCSI adapter, bus control logic, input/output ports, and memory. Sprouting from the center of this circuit board, a fabricated steel bracket holds another small board with the four slot connectors for the Model P75's expansion bus.

The microprocessor is on a separate 5- by 2.8-inch board at the top of the case; this board contains nothing more than 128K of ROM, a 66.6-MHz crystal, and the big 486 microprocessor (covered by a heat sink, which helps keep it cool). A 3- by 11-inch card directly adjacent to the processor board holds the XGA circuits.

The two Micro Channel connectors on top of this assembly use a full 32-bit interface, and one of the two has a VGA extension. The entire area above the connectors is open, allowing full-size Micro Channel boards to be installed. Two more connectors drop from the lower side of this assembly. These use only the 16-bit Micro Channel interface, and only short (6.5-inch) expansion boards can fit in that space. Both the long and short slots physically support expansion boards solely at the retaining bracket; IBM provides no guide at the far end of the boards.

The Model P75 has one built-in floppy disk drive, installed in a vertically pivoting bay at the front of the machine. A latch holds the drive securely out of the way when it is not needed. The spring-loaded bay slowly ejects the drive at the touch of a finger.

While the standard drive is a 1.44MB 3.5-inch unit, IBM sells both 5.25-inch and 3.5-inch external drives. The floppy disk control electronics, part of the Model P75's main circuit board, can operate the internal and one external drive.

The Model P75 includes three standard ports: one parallel, one serial, and one for a mouse. The connectors for these ports are hidden behind a pivoting door at the left rear corner of the machine. A sliding door covers the connectors during transit but allows the cables to protrude once the Model P75 has put down roots. Another sliding panel protects the power input jacks.

Also available behind the swinging door on the rear of the computer are connectors for an external display as well as floppy and SCSI hard disk drives. The SCSI host adapter circuitry on the main board operates as a Micro Channel bus master, but it does not contain substantial buffer memory. Consequently, it offers relatively modest performance compared with IBM's latest desktop SCSI systems.

The host adapter connects to the hard disk, which is mounted at the lower right of the chassis. Both 160MB and 400MB

VIDEO	
Video modes supported	VGA, XGA
Gray scales at maximum resolution	16
Interface	32-bit
Chip set manufacturer	IBM
Controller manufacturer	IBM
Controller location	Motherboard
Simultaneous external display	■
KEYBOARD	
Keys	101 total, 12 function, 4 cursor
Keyboard cable length	12 inches
Keypad connector/Keyboard connector	❑ / ■
SOFTWARE	
DOS	4.0 ($150)
OS/2	1.3 ($340)
Disk caching software	IBM
Expanded memory manager	None
Other	None
Internal modem	2,400 bps ($462)
Internal network card	Token-Ring ($772), 3270 ($667)
PHYSICAL FEATURES	
Power supply	120 watts
Dual voltage	■
Power-on/reset switch	Front/none
MISCELLANEOUS	
Car battery adapter available	❑
Coprocessor supported	None
Setup in ROM/Password in ROM	❑ / ■
Warranty	1 year
Service	Dealer
FCC certification class	B
FCC identification number	ANO8573D

drives are available for the Model P75, the larger drive adding $2,900 to the system's base price. Although IBM rates these drives as speed demons—with a 16-millisecond average access time for the 160MB drive and 11.5 ms. for the 400MB—the SCSI interface isolates them from DOS, so that PC Magazine Labs' DOS File Access test does not give a fair representation of their BIOS-mediated performance.

The SCSI specification insists that each device in a SCSI chain have its own identification number. IBM sets the default of the internal hard disk at 6, making it the highest-priority device. A three-bank DIP switch, easily accessible once the rear cover of the Model P75 is removed, allows you to alter this setting. Unfortunately the documentation of this feature is confusing.

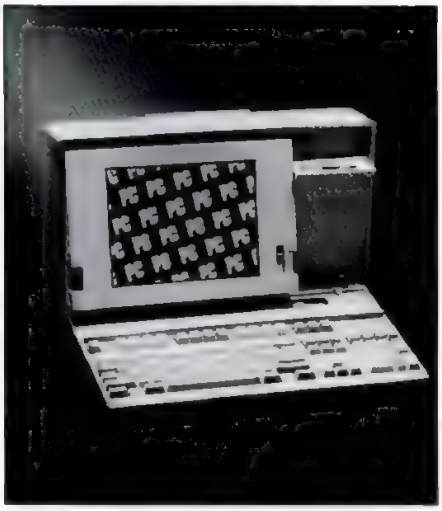
The system's slender 120-watt power supply fits neatly next to the hard disk in the bottom of the Model P75. As with most newer IBM computers, it automatically adjusts itself to accommodate either 115- or 230-volt 50- to 60-Hz AC. You need only change the power cord when you carry the Model P75 off to Europe or Japan.

Atop the power supply, a 3.5-inch fan—which is large for a portable—cools the chassis.

Four SIMM sockets on the main circuit board hold RAM. Two sockets come filled from the factory with 4MB 70-nanosecond SIMMs; the other two sockets accommodate either 2MB or 4MB SIMMs. More memory can be installed in the Model P75's 32-bit expansion slots. In either case, the maximum addressing capacity is 16MB.

XGA VIDEO

IBM builds the same XGA circuitry now used on its top-of-the-line desktop machines into the Model P75. With compatible monitors (those capable of handling the interlaced images of IBM's 8514/A and XGA display adapters, with frame rates of 44 Hz and field rates of 88 Hz), the XGA circuitry achieves 1,024- by 768-pixel on-screen resolution. The XGA circuitry automatically detects whether a



IBM Personal System/2 Model P75 486, $15,990.

color or monochrome VGA or 8514-style monitor is attached and adjusts itself to take advantage of the monitor's capabilities. The 1MB of video memory that comes standard—four soldered-down 100-ns. VRAM chips—allows it to display up to 256 simultaneous colors at its highest resolution.

The Model P75's internal display is a high-contrast gas-plasma screen limited to VGA's 640- by 480-pixel resolution. Its 8.3- by 6.5-inch neon-orange screen can show up to 16 levels of intensity.

The screen pivots at its top to let you adjust the viewing angle, but the single brightness control has so little range that it might be considered superfluous. To prolong the life of the screen, the display automatically switches off after 10 minutes of keyboard inactivity.

The screen's picture element size is fixed; consequently, images that contain fewer than 480 display lines do not fill the full height of the screen. Although the Model P75 will display CGA and EGA images, the active screen area is limited to a band across the middle of the display. For example, the Model P75's standard 400-line text mode fills only about 83 percent of the full screen height.

The XGA circuitry is relatively fast. It's also a bus master, so its speed is independent of the microprocessor. In direct memory transfers, it is about as quick as any VGA adapter on the market, including the internal VGA system of the Compaq Deskpro. IBM includes drivers to match the system, so that both the internal gas-plasma display and the external monitors (including color) will work with *Microsoft Windows* 3.0, OS/2 Presentation Manager (Versions 1.2 and 1.3), and *AutoCAD*. An *AutoCAD* display list driver is also provided.

ENHANCED KEYBOARD

The Model P75's keyboard has the same 101-key layout as the full-size IBM Enhanced keyboard. It's a bit narrower, however, because its right and left margins have been trimmed off. Because it lacks the familiar IBM tactile key click, it's not as pleasant to type on as a desktop keyboard.

The Model P75 is your top choice; it's simply the fastest portable you can buy.

The keyboard is tethered to the system unit by a retractable cable that extends from 16 to 48 inches long. You can detach the cable at the keyboard end and plug in a 10-foot extension. Normally this cable is stowed in a slot in the top of the keyboard. The keyboard's top edge pivots to make a wide foot for holding it at a comfortable typing angle. It latches to the system unit and becomes a protective front panel when the machine is carried.

When you close the system, a tab at the top edge of the keyboard automatically presses off the on/off rocker switch at the right front edge of the chassis. Be careful: If you forget to save your data, you'll lose it when you close the case.

If you need all the power and features of a 486 in a package you can carry with you, the IBM PS/2 Model P75 is your top choice—and your only choice. It's simply the fastest portable PC you can buy. ■

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-Computer Monthly, PC Brand 286/16, Product Review

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- True 80286-16/20 with Zero Wait States
- Landmark Speeds: 20.6MHz *(286/16)*, 26.7MHz *(286/20)*
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- 512K RAM *(expandable to 8MB)*
- 1.2MB or 1.44MB Floppy Drive
- 101 Key Click/Tactile Keyboard
- 1 Parallel and 2 Serial Ports

16MHz **$549**

20MHz **$649**

286/16 and 286/20 Mono Packages

This preconfigured system includes all the features of our base systems with:

- 512K RAM *(expandable to 8MB)*
- 40MB/25Ms Hard Drive
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- 1.2MB or 1.44MB Floppy Drive
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Standard Features

- 80286-16, 80286-20 operating at 16MHz or 20MHz with Zero Wait States
- 512K RAM expandable to 8MB on the System Board
- 1:1 interleaved Hard/Floppy Drive Controller, with 1MB second disk transfer rate
- 1 Parallel and 2 Serial Ports
- High capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 80287 Co-Processor Support
- Industry Standard BIOS with full MS/DOS, OS/2, XENIX, NOVELL,3COM, and PCNET compatibility
- Built in System Board LIM 4.0EMS hardware
- 7 Slot Motherboard Design (5 16bit & 2 8bit)
- Medium Footprint Desktop Case with 6 Disk Drive Bays

Hard Drive Options

- 40MB/25MS
- 80MB/19MS
- 125MB/19MS
- 170MB/15MS
- 200MB/16MS
- 320MB/16MS
- 640MB/16MS

Case Options

- Slim Line
- Mini Tower
- Full Size Tower

Video Options

- Mono Graphics
- VGA Mono
- VGA Color (640 x 480)
- Super VGA Color (1024x768)

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Computer Buyer's Guide, PC Brand 386SX-16, Product Review

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386/SX-16 Non Cache and 386/SX-20 Cache Base Systems

Customize with the Video and Hard Drive options of your choice

- True 386™SX™ Processor operating at 16MHz or 20MHz w/Zero Wait States
- Landmark Speeds: 18.3MHz *(SX-16)*, 28.9MHz *(SX-20)*
- Norton SI 18.7 *(SX-16)* 23.4 *(SX-20)*
- 512K RAM *(expandable to 8MB)*
- 16K CPU Ram Cache *(SX-20 only)*
- 1.2MB or 1.44MB Floppy Drive
- 101 Key Click/Tactile Keyboard
- 1 Parallel and 2 Serial Ports

$799

$899

386/SX-16 Non Cache and 386/SX-20 Cache Super VGA Packages

This preconfigured system includes all the features of our base systems with:

- 2MB RAM *(expandable to 8MB)*
- 40MB/25Ms Hard Drive
- 14" Super VGA *(1024 x 768 Resolution)* Color Monitor
- 16 Bit High Performance Super VGA Card with 1MB Video RAM
- Dual 1.2MB and 1.44MB Floppy Drives
- High Resolution Mouse

$1,874

$1,974

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Standard Features

- True 386™SX™ Processor operating at 16MHz or 20MHz with Zero Wait States
- 512K RAM expandable to 8MB on the System Board
- 16K CPU RAM Cache (SX-20 only) with Posted Write and Writeback Logic
- 1:1 interleaved Hard/Floppy Drive Controller, with 1MB second disk transfer rate
- 1 Parallel and 2 Serial Ports
- High capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 387™SX™ Co-Processor Support
- Industry Standard BIOS with full MS/DOS, OS/2, XENIX, NOVELL,3COM, and PCNET compatibility
- 8 Slot Motherboard Design (5 16bit & 3 8bit)
- Medium Footprint Desktop Case with 6 Disk Drive Bays

Hard Drive Options

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- 80MB/19MS
- 125MB/19MS
- 170MB/15MS
- 200MB/16MS
- 320MB/16MS
- 640MB/16MS

Case Options

- Slim Line
- Mini Tower
- Full Size Tower

Video Options

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- VGA Mono
- VGA Color (640 x 480)
- Super VGA Color (1024x768)

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386/25 Base System

Customize with the Video and Hard Drive options of your choice

- True 25MHz Intel 80386 operating with Zero Wait States
- Landmark Speed: 33.6MHz
- Norton SI 28.2
- 1MB RAM *(expandable to 16MB)*
- 1.2MB or 1.44MB Floppy Drive
- 101 Key Click/Tactile Keyboard
- 1 Parallel and 2 Serial Ports

25MHz **$999**

386/25 Super VGA Package

This preconfigured system includes all the features of our base systems with:

- 4MB RAM *(expandable to16MB)*
- 80MB/19Ms Hard Drive
- 14" Super'VGA *(1024 x 768 Resolution)* Color Monitor
- 16 Bit High Performance Super VGA Card with 1MB Video RAM
- Dual 1.2MB and 1.44MB Floppy Drives
- High Resolution Mouse

25MHz **$2,333**

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Standard Features

- True 25MHz Intel 80386 CPU Operating with Zero Wait States
- 1MB RAM expandable to 16MB on the System Board
- 1:1 interleaved Hard/Floppy Drive Controller, with 1MB second disk transfer rate
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- 8 Slot Motherboard Design (5 16bit & 3 8bit)
- Medium Footprint Desktop Case with 6 Disk Drive Bays

Hard Drive Options

- 40MB/25MS
- 80MB/19MS
- 125MB/19MS
- 170MB/15MS
- 200MB/16MS
- 320MB/16MS
- 640MB/16MS

Case Options

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Product Review

386/25MHz and 386/33MHz Cached ISA Systems

386/25 and 386/33 Cache Base Systems

Customize with the Video and Hard Drive options of your choice

- True 25MHz or 33MHz Intel 80386 CPU operating with Zero Wait States
- Landmark Speeds: 43.5MHz *(386/25 Cache)*, 58.7MHz *(386/33 Cache)*
- Norton SI 31.6 *(386/25 Cache)*, 45.9 *(386/33 Cache)*
- 1MB RAM *(expandable to 8MB)*
- 1.2MB or 1.44MB Floppy Drive
- 101 Key Click/Tactile Keyboard
- 1 Parallel and 2 Serial Ports

25MHz **$1,199**

33MHz **$1,399**

386/25 and 386/33 Cache Super VGA Packages

This preconfigured system includes all the features of our base systems with:

- 4MB RAM *(expandable to 16MB)*
- 125MB/19Ms Hard Drive
- 14" Super VGA *(1024 x 768 Resolution)* Color Monitor
- 16 Bit High Performance Super VGA Card with 1MB Video RAM
- Dual1.2MB and 1.44MB Floppy Drives
- High Resolution Mouse

25MHz **$2,654**

33MHz **$2,854**

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Standard Features

- True 25MHz or 33MHz Intel 80386 CPU operating at 16MHz or 20MHz with Zero Wait States
- Direct Map Cache Processor with 64K Static Ram Standard
- 4MB RAM expandable to 16MB on the System Board
- 1:1 interleaved Hard/Floppy Drive Controller, with 1MB second disk transfer rate
- 1 Parallel and 2 Serial Ports
- High capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 387™or Weitek Co-Processor Support
- Industry Standard BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL, 3COM, and PCNET compatibility
- 8 Slot Motherboard Design
- Medium Footprint Desktop Case with 6 Disk Drive Bays

Hard Drive Options

- 40MB/25MS
- 80MB/19MS
- 125MB/19MS
- 170MB/15MS
- 200MB/16MS
- 320MB/16MS
- 640MB/16MS

Case Options

- Slim Line
- Mini Tower
- Full Size Tower

Video Options

- Mono Graphics
- VGA Mono
- VGA Color (640 x 480)
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Personal Computing, 10 Best Mail Order Companies

486/25MHz and 486/33MHz Cached ISA Systems

486/25 and 486/33 Base Systems

Customize with the Video and Hard Drive options of your choice

- True 25MHz or 33MHz Intel 80486 CPU operating at Zero Wait States
- Landmark Speeds: 114.1MHz *(486/25)*, 150MHz *(486/33)*
- Norton SI 41.5 *(486/25)*, 51.5 *(486/33)*
- 1MB RAM *(expandable to 32MB)*
- 1.2MB or 1.44MB Floppy Drive
- 101 Key Click/Tactile Keyboard
- 1 Parallel and 2 Serial Ports

25MHz $1,949

33MHz $3,399

486/25 and 486/33 Super VGA Packages

This preconfigured system includes all the features of our base systems with:

- 4MB RAM *(expandable to 32MB)*
- 125MB/19Ms Hard Drive
- 14" Super VGA *(1024 x 768 Resolution)* Color Monitor
- 16 Bit High Performance Super VGA Card with 1MB Video RAM
- Dual 1.2MB and 1.44MB Floppy Drives
- High Resolution Mouse

25MHz $3,404

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Standard Features

- True 25MHz or 33MHz Intel 80486 CPU Operating at Zero Wait States
- 1MB RAM expandable to 32MB
- Built-in 8K 4-Way Set Associative Cache
- Built-in Intel 487 Numeric Coprocessor
- Optional 128K or 256K auxillary CPU Cache Card
- Optional Weitek Card
- 1:1 interleaved Hard/Floppy Drive Controller, with 1MB second disk transfer rate
- 1 Parallel and 2 Serial Ports
- High capacity 200 Watt System Power Supply
- Real Time Clock/Calendar with 5 Year Battery
- 7 Slot Motherboard Design with one 32bit proprietary Zero Wait State Slot
- Industry Standard BIOS with full MS/DOS, OS/2, XENIX, UNIX, NOVELL,3COM, and PCNET compatibility
- Medium Footprint Desktop Case with 6 Disk Drive Bays

Hard Drive Options

- 40MB/25MS
- 80MB/19MS
- 125MB/19MS
- 170MB/15MS
- 200MB/16MS
- 320MB/16MS
- 640MB/16MS

Case Options

- Slim Line
- Mini Tower
- Full Size Tower

Video Options

- Mono Graphics
- VGA Mono
- VGA Color (640 x 480)
- Super VGA Color (1024x768)

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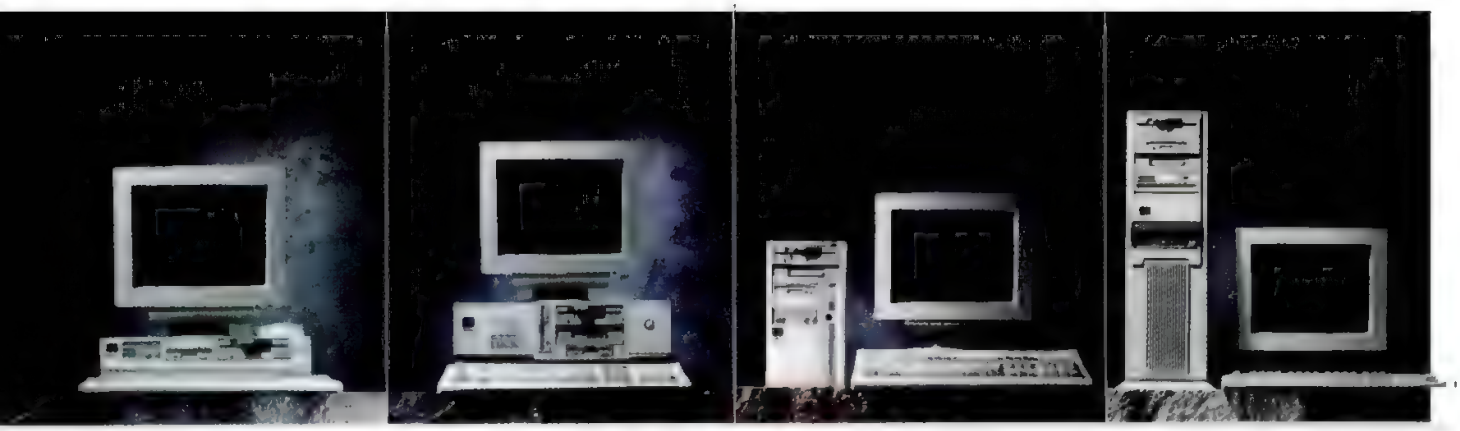

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Convenience On the Go

PORTABLE PERIPHERALS

An explosion of accessories for portable computers can help you attain full on-the-road productivity.

BY BRUCE BROWN

Computing while on the road is not only becoming more commonplace, it's also becoming more complex. No longer are portable-computer users impressed—or even satisfied—with merely a movable processor. Portable power, speed, and data storage have all increased dramatically, and versatility has soared with them. An expanding number of on-the-go applications have created an almost overnight demand for new portable peripherals. But is a kit bag of assorted laptop add-ons really for you? We've taken a close look at this new product category to help you find out.

ILLUSTRATION: JAMES NAZZ

PORTABLE PERIPHERALS

As you gain experience with portable computing, the missing pieces you take for granted at most desktop computing sites may become more important while you're on the road. You may find that you can't do without a portable printer, scanner, modem, fax machine, external hard disk, tape drive, or mouse, or even a convenient way to use the laptop and a printer in your car.

Most peripherals fall into one of two categories: productivity and convenience. Productivity-enhancing peripherals—portable printers, hard disks, fax modems, and car-battery–adapter power supplies— go further, allowing portable PC users to be more independent of host desktop systems or regular AC power. Products such as computer cases, floppy-disk folders, and software that enlarges the on-screen cursor so it can be better seen on liquid crystal displays are examples of convenience-oriented add-ons. They don't add to the working potential of your portable computer; they just make it nicer. Call these human-factor peripherals.

Canon BJ-10e

The $495 Canon BJ-10e ink jet printer weighs about 4.5 pounds. It runs on batteries or AC and emulates both the Canon BJ-130e and the IBM Proprinter X24E.

PHOTOGRAPHS: WALTER CHRYNWSKI

Naturally, as the market for portable peripherals grows, there'll be plenty of products you can ignore, either because they're not worth the money or, more likely, because they aren't worth the extra weight. Examples of possibly superfluous peripherals include a leg that helps stabilize your laptop when you hold your knees slightly apart, and a flexible keyboard cover that protects the unit from spills, dust, and debris. (Of course, there's always a danger in calling something superfluous. You might discover 20,000 people for whom extra computer legs are a gift from above, or a bunch who work in such hostile conditions that a keyboard cover could eliminate months in the repair shop.)

In this story, we'll examine three of the most popular productivity-enhancing categories of portable peripherals: printers, external hard disks, and alternate pointing devices. We'll also take a general glance at some of the other traveling computing accessories available.

PORTABLE PRINTING

Printing while you're away from your office can be inconvenient at best when it requires a hookup to the printer in a client's office. For those who don't want to annoy their hosts, or who visit printerless offices or homes, portable printers that plug into your laptop are just the thing. All at once the traveler can safely leave proposals, hard-copy drafts, and even invoices behind.

The minimum requirements for portable printers are small size and light weight. Battery operation is handy but not crucial if you're going to be using your printer mainly in a hotel room or in someone's office. Six printers currently compete in the portable market, with new entries soon to come.

Eastman Kodak Co. has been selling its portable, battery-operated Diconix printers since 1986. The $519 Diconix 150 Plus is a thermal ink jet printer measuring 2 by 10.8 by 6.5 inches (HWD) and weighing just under 4 pounds with batteries. The Diconix 150 Plus uses plain, single-sheet or continuous-feed paper and emulates both the IBM Proprinter and Epson FX80/85 9-pin dot matrix printers.

Productivity-enhancing peripherals allow portable PC users to be more independent of host desktop systems or regular AC power.

It runs on five nickel cadmium C cells and can print for approximately 1 hour before you need to recharge the batteries. The printer won an Editors' Choice award in our 1989 printer blockbuster issue ("Portable Printers," *PC Magazine*, November 14, 1989); on PC Labs' text speed test, it ran at 70 characters per second in draft mode and 31 cps in near-letter-quality mode, and 0.4 graphics pages per minute (gppm) on our graphics speed test. A parallel printer port is standard on the 150 Plus, and an optional serial port brings the list price to $539.

Canon's USA's bubble jet printer—the $495 BJ-10e—weighs about 4.5 pounds with the optional $50 rechargeable nickel cadmium battery pack, and it measures 1.9 by 12.3 and 8.5 inches. The printer emulates an IBM Proprinter X24E and connects to the computer via a parallel interface port. This machine won an Editors' Choice award in last year's printer

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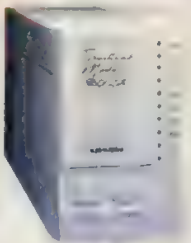

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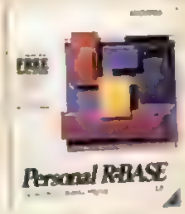

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blockbuster issue (see "Ink Jets," November 13, 1990), where it ran through PC Labs' text speed test at about 40 cps in both default and economy modes and printed 0.6 gppm on the graphics speed test. A word of caution: While you can feed the BJ-10e single sheets of paper, it works much better with the $90 optional 30-sheet feeder.

Computer Products Plus offers a diminutive 1.3- by 11.5- by 6.7-inch 3.5-pound thermal printhead printer called the World's Smallest Printer? WsP-200. This model runs on standard C cells or rechargeable nickel cadmium batteries and uses specially coated fax-style thermal paper. The $399.95 WsP-200 worked its way through PC Labs' text speed test at a turtlesque 14 cps in its only print mode, and it finished the graphics speed test at 0.4 gppm. The printer connects to a computer via a parallel port and includes a short parallel cable. It emulates the Epson LQ series of printers. (For additional information, see New & Improved, December 11, 1990.)

Toshiba America sells two 24-pin dot matrix printers for the portable computer market, the ExpressWriter 301 and ExpressWriter 311. Both of these machines were reviewed in our 1989 printer blockbuster issue (see "Portable Printers: On-the-Road Output," November 14, 1989).

The $489 ExpressWriter 301 measures 3 by 12.2 by 5.5 inches and weighs 4 pounds. It runs on AC power or on standard rechargeable nickel cadmium batteries and can print for about 1 hour per charge. The 301 is compatible with the Epson LQ and Toshiba/Qume P321 and it connects via the parallel port. This model accepts only single sheets of paper, fed manually. It crawled through PC Labs' text speed test at 16 cps in both its draft and letter-quality modes, but it did better on the graphics speed test, coming in at a respectable 0.4 gppm.

The $589 ExpressWriter 311 is an 11-pound unit that can be considered a portable mainly because it has a handle and a built-in compartment to hold the power cord. The 311 measures 4.8 by 15.7 by 12.5 inches. It clobbered its cousin on PC Labs' text speed test, zooming in at 73 cps in draft mode and 35 cps in a very crisply impressive NLQ mode. It also churned through the graphics speed test at an eyebrow-raising 0.6 gppm. You can feed paper via a single-sheet friction feed or a detachable pull tractor. Standard emulations are for the Epson LQ, IBM Proprinter, and Toshiba/Qume P321.

As we went to press, Seikosha America entered the portable printer market with the $499 Seikosha LT-20. This laptop printer uses a cut-sheet paper cassette, and it prints up to 100 pages with a single charge of its nickel cadmium battery, according to the vendor. The LT-20 attaches via the computer's parallel port, weighs just over 7 pounds with 50 sheets of paper installed, and measures 2 by 14.6 by 11.3 inches. The LT-20 uses a 24-pin dot matrix design with an IBM Proprinter X24 emulation, and it comes with a resident NLQ font. We saw a preproduction model that ran through our text speed test at 40 cps in draft and 28 cps in NLQ mode at 10 characters per inch. Like the ExpressWriter 311, the LT-20 also scored 0.6 gppm on the graphics speed test.

Kodak Diconix 150 Plus
Eastman Kodak Co., Rochester, NY 14653; 800-344-0006.
List Price: $419; serial port, $20.
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Canon BJ-10e
Canon USA Inc., Information Systems Division, One Canon Plaza, Lake Success, NY 11042; 800-848-4123, 516-488-6700.
List Price: $495; cut-sheet feeder, $90; nickel cadmium battery pack, $50.
CIRCLE 397 ON READER SERVICE CARD

World's Smallest Printer? WsP-200
Computer Products Plus Inc., 16351 Gothard St., Huntington Beach, CA 92647; 800-274-4277, 714-847-1799.
List Price: $399.95.
CIRCLE 398 ON READER SERVICE CARD

Toshiba ExpressWriter 301
Toshiba ExpressWriter 311
Toshiba America, Information Systems, 9740 Irvine Blvd., Irvine, CA 92718; 800-457-7777.
List Price: ExpressWriter 301, $489; ExpressWriter 311, $589.
CIRCLE 399 ON READER SERVICE CARD

Seikosha LT-20
Seikosha America Inc., 10 Industrial Ave., Mahwah, NJ 07430; 800-338-2609, 201-327-7227.
List Price: $499.
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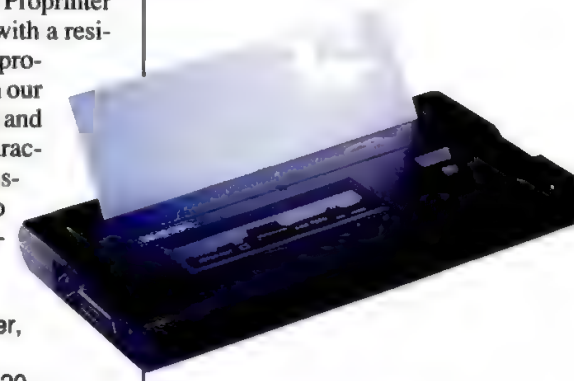
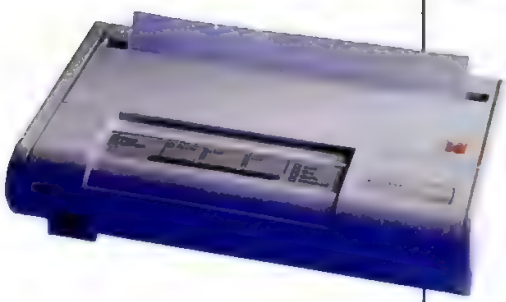


World's Smallest Printer? WsP-200

Computer Products Plus' $399.95 WsP-200 thermal printer runs on batteries or AC. It weighs only 3.5 pounds and emulates the Epson LQ series.



Kodak Diconix 150 Plus

Eastman Kodak's Diconix 150 Plus ink jet printer can run on batteries or AC and emulates the Epson FX80/85 and the IBM Proprinter. The 150 Plus weighs in at just under 4 pounds.

EXTERNAL HARD DISKS: DATA LUGGAGE FOR LAPTOPS

External hard disks serve multiple purposes for portable computers. When paired with notebook or laptop computers that don't already have a hard disk, external units can serve as primary storage for programs and data that are either left at the office or carried along for access when AC power is available. If your portable already has an internal hard disk, you may want to consider buying an external one as a secondary large-capacity storage device or as a fast, software-accessible data backup unit.

While several vendors sell add-on hard disks for specific brands and models, we were especially interested in units that work with any brand of portable computer. Rather than hooking to the computer via a proprietary drive port, these external hard disks plug into either the parallel or serial port. While data transfer speed is limited to the maximum transfer rates permitted by the host computer's parallel or serial interface, the convenience of adding a primary or secondary large-capacity storage device may be worth the performance hit.

Axonix manufactures a series of external hard disks called the Datafiles line. Capacities range from 20MB to 200MB, and prices range from $799 to $2,299. The drives attach via the parallel port.

Axonix Datafile
Axonix Corp., 1214 Wilmington Ave., Salt Lake City, UT 84106; 800-866-9797, 801-466-9797.
List Price: 20MB hard disk, $799; 40MB hard disk, $999; 100MB hard disk, $1,399; 200MB hard disk, $2,299.

CIRCLE 401 ON READER SERVICE CARD

RODENTS ON THE ROAD

The rapidly increasing popularity of graphical user interfaces (GUIs), especially *Microsoft Windows* 3.0, hasn't been ignored by portable users; these products have simply been out of their reach. Two problems have kept GUIs from becoming popular with the laptop crowd: display quality and display speed insufficient for a mouse. With the advent of VGA LCD screens (especially the triple-supertwist variety), the screens now have good enough resolution for *Windows* 3.0 (as long as you work in monochrome, which means you lose a large part of *Windows*' color cueing advantages).

If your screen is okay, the next hurdle is the pointing device. Desktop mice are fine if you leave your portable on a desk, but traveling laptops and notebook computers often have barely enough room for themselves (on airplane flip-down trays, for example). Trying to use a mouse on your lap or in your hand is a tiresome activity. Some people have found a trackball more helpful, and there are always some slightly oddball entries, such as the MousePenPortable from Appoint (Paso Robles, CA; 800-448-1184). This $149 mouse pen, designed for portables, comes bundled with *TelePaint*, a VGA paint program. (See New & Improved, October 16, 1990, for more information.) Obviously, the market for pointing devices appropriate for portables is just emerging and is about to get much bigger.

The most notable unit currently available is from Suncom Technologies. The Suncom ICONtroller, Laptop Version, sells for $99.95 and plugs into the computer's serial port; it is both Microsoft and Mouse Systems compatible.

The ICONtroller looks like a miniature joystick mounted on a small case. There are three buttons on the case and one small button on the joystick's end; this small button is used for selecting, activating, and dragging like the left button on a Microsoft Mouse. You can take your ICONtroller one step further by configuring it to act like a one-, two-, or three-button rodent. You can attach the ICONtroller to the side of your computer with a Velcro-like material or hold it in your hand and move the direction stick with your thumb and still push its button easily. This design feels right and works well.

Two other alternate pointing device technologies are the Isopoint Controller and the Home Row Pointing Device. Both devices are available only from third-party laptop manufacturers because they must be installed during the PC's production process. The Isopoint Controller, from Culver Research (Woodside, CA; 415-851-1202), is a horizontal roller device mounted just below the Spacebar. Moving it left, right, up, and down directs the movement of an on-screen pointer. The GRiD 1550SX is the only portable that currently uses the Isopoint device.

The Home Row Pointing Device (Home Row Inc., Clackamas, OR; 503-656-2995) utilizes a patented force-sensing mechanism that fits around an existing key switch. The mechanism is mounted

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PC MAGAZINE EDITORS' CHOICE

WHAT'S ONE WITHOUT THE OTHER? KODAK

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CIRCLE 362 ON READER SERVICE CARD

under the key cap so you'd never know it's there just by looking at the keyboard. Home Row is typically used with the J key as the direction indicator; left "home row" keys, usually F and D, are used as the primary and secondary mouse "buttons." To use the Home Row pointing capability, you exert pressure sideways on the J key, which senses the lateral force and moves the on-screen cursor or pointer.

As GUIs and portables grow in popularity, you can expect to see more built-in pointing devices as well as aftermarket hand-held mouse alternatives. Expect some great new products to arrive quite soon from the desktop-pointing-device market leaders.

Suncom ICONtroller
Suncom Technologies, 6400 W. Gross Point Rd., Niles, IL 60648; 708-647-4040.
List Price: $99.95.

CIRCLE 402 ON READER SERVICE CARD

CALLING HOME: PORTABLE MODEMS AND FAX MODEMS

Calling home is often a necessity for the mobile office worker. While most portable computer vendors offer internal modem options, many people prefer to use an external version because they'd rather not tie up a slot. Three companies that sell external portable modems are Practical Peripherals (Westlake Village, CA; 800-442-4774), Touchbase Systems Inc. (Northport, NY; 800-541-0345), and Vocal Technologies Ltd. (Santa Clara, CA; 408-980-5181).

While modems allow you to download files and manipulate them with your computer, an important distinction must be made between these portable modems and fax modems. Faxing is a "send, receive, and read" technology. The portable fax modems you can buy are mostly send-only devices, though some offer the receiving capability as well. When you receive a file, you can read it on-screen and possibly print it out, but you won't be able to manipulate it like any other PC file. An on-screen fax is a bitmapped image of whatever you're looking at, the text it contains cannot be easily converted into a word processing format. By contrast, since any pictures sent this way are generally bitmapped graphics, they can be edited to a limited degree (with the accent on "limited"—you still couldn't pull one into a CAD application, for instance). Hayes Microcomputer Products Inc. (Norcross, GA; 404-441-1617) and Touchbase Systems Inc. (Northport, NY; 800-541-0345) are two companies that sell portable external fax modems.

HELP FOR YOUR EYES

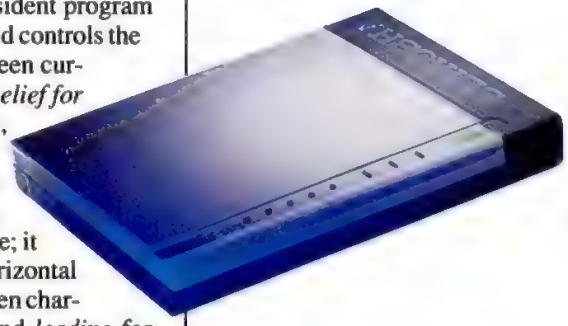
Working with laptop LCD screens, especially the earlier-generation units, can be tiring—not because of radiated bright light, but because it's often hard to find the cursor and sometimes even difficult to read the characters.

SkiSoft Publishing Corp. (Lexington, MA; 800-662-3622) publishes two programs specifically for laptop LCD-screen users that make it easier to see what's going on. *No-Squint II Cursor Enhancer* ($49.95) is a 5K RAM-resident program that enlarges, brightens, and controls the blinking rate of the on-screen cursor for LCD panels. *Eye Relief for Laptops* ($129.95) is a 90K, full-function word processing program that lets you use on-screen letters up to four times normal size; it also lets you control the horizontal and vertical spacing between characters and lines— *pitch* and *leading* for those who think in desktop publishing terms. (For more information on both of these products, see New & Improved, December 11, 1990.)

If these software solutions still don't solve your small-screen problems, Reflection Technology (Waltham, MA; 617-890-5905) has an answer: Go even smaller. This company's Private Eye, which was a finalist for *PC Magazine*'s 1990 Award for Technical Excellence, produces a "virtual" 12-inch-diagonal full-screen display with monochrome CGA resolution, which can be seen by looking into a 1-inch eyepiece suspended from a headband. The 720- by 280-dot per inch display is superimposed on your field of vision, and the effect is a screen image that appears to be about 2 feet in front of you. The PC Private Eye lists for $795, including the headset with display unit, a half-length 8-bit interface card, a 5-foot cable, and software. All you need now is something to carry it in.

THE CASE FOR CASES

With the exception of hand-held computers, which fit in a jacket or coat pocket, and 20-plus-pound luggables, which are cases in themselves, portable computers are usually carried in something. Note-



Seikosha LT-20

The 24-pin, $499 Seikosha LT-20 uses a cut-sheet paper cassette and can reportedly print up to 100 pages on a single charge of its nickel cadmium battery. It connects to your parallel port and weighs just over 7 pounds with paper installed.

The difference betw fax board and

Intel's new SatisFAXtion™ fax board costs less than $500. And while that prices it well under some fax boards, there are still cheaper alternatives.

So we thought it only fair to explain what you'll be getting with ours.

Or, missing with theirs.

1. The SatisFAXtion board is the only one that lets you fax a document exactly as you'd send it to your printer. One step, five seconds, and you're back to work. There's no easier way to fax—period.

2. With the SatisFAXtion board you get true WYPIWYF™—what you print is what you fax. Text is never distorted, fonts never switched, formats never lost. You can even connect a scanner and fax photo-quality images with up to 256 levels of grey.

3. Once a fax starts coming in or going out, most boards bring the work your computer's doing to a screeching halt. Even a simple fax could tie up your PC for several minutes. But the SatisFAXtion board has its own dedicated 16 MHz microprocessor. All your faxing happens entirely in the background, so you and your PC don't skip a beat.

4. The SatisFAXtion board automatically configures and installs itself in your PC. Cheaper boards are a nuisance, with DIP switches, jumpers, and long, convoluted procedures to mess with.

5. If you ever have a question about your SatisFAXtion board, you can get answers directly from Intel experts—either by phone, fax, or modem.

6. Offices don't communicate by fax alone, so the SatisFAXtion board gives you a built-in MNP 5 modem that works twice as fast as ordinary modems. This alone is worth $300!

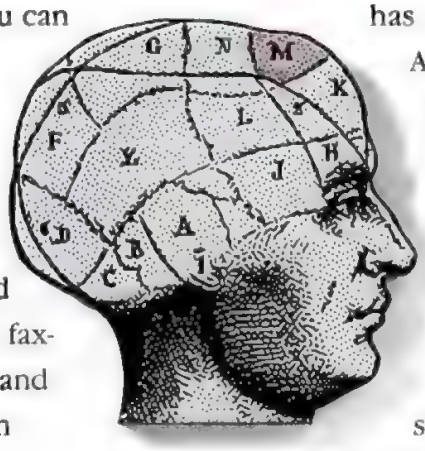
7. While cheaper boards hog over 100K of conventional memory just to send a fax—even if your PC has expanded RAM—the SatisFAXtion board needs as little as 9K.

Ordinary fax boards make you look this bad.

The *SatisFAXtion* board makes you look this good.

een an inexpensive a cheap one:

Which means you can easily fax from within even the most powerful, memory-hungry applications.



8. If you need help while you're faxing, just press F1 and follow the built-in directions.

9. Our board is covered by a 5-year warranty—more than twice as long as cheaper fax boards. (We'll leave it to you to figure out what that implies.)

10. No other fax board is designed to run crash-free under Windows 3.0. Just load *FAXit® For Windows* software—which, by the way, is free to all SatisFAXtion buyers—onto your PC, and you can fax directly from any Windows 3.0 application that can print.

11. What more could we add to the fax board that has everything?

Actually, quite a bit: For a limited time, when you buy the SatisFAXtion board you'll also get *PC Tools Deluxe*™ software free, as well as $100 worth of discounts on other PC hardware and software products.

If you'd like to learn more—and believe us, there's plenty more to learn—just call (800)525-3019 and ask us to fax you document #9996. Or call Intel customer service at (800)538-3373.

Suggested retail price of Intel's new SatisFAXtion board.

We think you'll find that the difference between a cheap fax board and an inexpensive one can really be summed up in one word: SatisFAXtion.

intel®

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CIRCLE 374 ON READER SERVICE CARD

book computers, which by name should measure approximately 1 to 3 inches by 11 by 8.5 inches, often fit comfortably in attaché cases; but laptops usually require their own cases, and even notebooks are often carried with so many other pieces (AC adapters, cables, and floppy disks) that at times it's necessary to carry them in their own bags.

Most vendors either include carrying cases as standard equipment or sell them as options. Usually, however, the vendor-supplied cases hold only the computer with minimal extra room—which is no help at all if you want to take along even the tiniest printer on the market. Of course, you can always use soft-luggage single and double attaché cases from companies such as Eddie Bauer, Lands End, or L.L. Bean, but you should also consider third-party cases made especially for portable computers.

While many companies manufacture and sell portable-computer carrying cases, two companies stand out for their durable, roomy products. Targus (Buena Park, CA; 714-523-5429) sells the nylon Lappac for $99 and the Classic Leather Lappac for $199. The Targus Premier Leather case ($299) holds up to 50 pounds of computers, peripherals, and other materials, and measures 14 by 18 by 7 inches, including a sturdy foam-padded main compartment to protect your valuable portable.

The Tenba line from Quality Cases Ltd. (New York, NY; 212-966-1013) features the Computer Traveler. It is available in different lengths and heights; all can be expanded to 7 inches and can carry real notebooks, newspapers, and loads of other material in addition to your computer and essential peripherals. Depending on size, the Tenba Computer Traveler cases range in price from $140 to $170.

Axonix Datafile

The Axonix Datafile external hard disk connects to your portable's parallel port. It ranges in size from 20MB to 200MB and in price from $799 to $2,299.

Suncom ICONtroller

Suncom's $99.95 ICONtroller alternate pointing device connects to your laptop's serial port. It is compatible with Microsoft and Mouse Systems mice and can be hand-held or attached to the side of your keyboard.

PERIPHERAL SOURCES: WHERE TO BUY

Two companies specialize in accessories for portable computer users and publish catalogs with their own and other vendors' products. In the next few years, you can expect to see more companies focusing on portable computing accessories.

Traveling Software (Bothell, WA; 800-343-8080), publisher of *LapLink* and *Battery Watch* (two software products aimed at the portable market), has until recently published a large mail-order catalog filled with convenience- and productivity-enhancing peripherals for users of all brands of portable PCs. Besides selling the company's own software, the catalog included everything from portable computer cases to portable modems, printers, and remote keyboard controllers. The company's new catalog will be smaller and aimed primarily at Traveling Software's own products, but it should still be a valuable buying source.

Computer Products Plus Inc. (Huntington Beach, CA; 800-274-4277) specializes in accessories for Toshiba portables but also carries many products that aren't Toshiba-specific. Computer Products Plus's catalog includes its own $49.95 Road Warrior Tool Kit (with tools and devices to aid in making telephone line connections for modem communications), modems and fax modems, numeric keypads, keyboard overlays and covers, a Velcro-attached laptop leg, battery packs, battery chargers, laptop UPSs, AC adapters, printers, overhead projectors, scanners and copiers, external hard disks, floppy disk and tape drives, network cards, expansion chassis, hand-held computers, computer cases, and portable computer productivity-enhancing software, memory, hard disk, and screen upgrades.

Don't waste space on peripherals that drag you down without improving productivity.

Don't let these catalogs be your only resource for portable peripherals, though. Plenty of vendors will sell to you directly or through the retail market. Just be sure you have a sturdy case to lug around all your new laptop sidekicks in.

These are only some of the portable peripherals now available, and more are arriving almost daily. Get what you need, but be careful. Don't waste space and money on cute techie peripherals that will only drag you down without improving your productivity. There's little advantage in using a 6-pound notebook computer if you heave it around in a 7-pound case that's weighted down with another 25 pounds of unnecessary extras. If your computer is all you need, don't burden yourself with portly peripherals you could do without. ■

Bruce Brown is a contributing editor of PC Magazine.

Here's what they're saying about Ami Pro from Lotus.

"

Independent User Survey For Windows.™*			
Word Processing Features	Ami Pro *for Windows*	Word for Windows	WordPerfect for DOS
Best Overall	50%	22%	16%
Ease of Learning	47%	28%	8%
Ease of Use	52%	23%	8%

"

*Independently commissioned Windows word processor Usage and Attitude Study conducted November 1990

Here's why th

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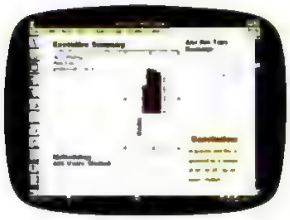

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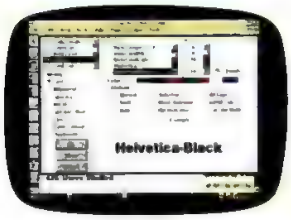

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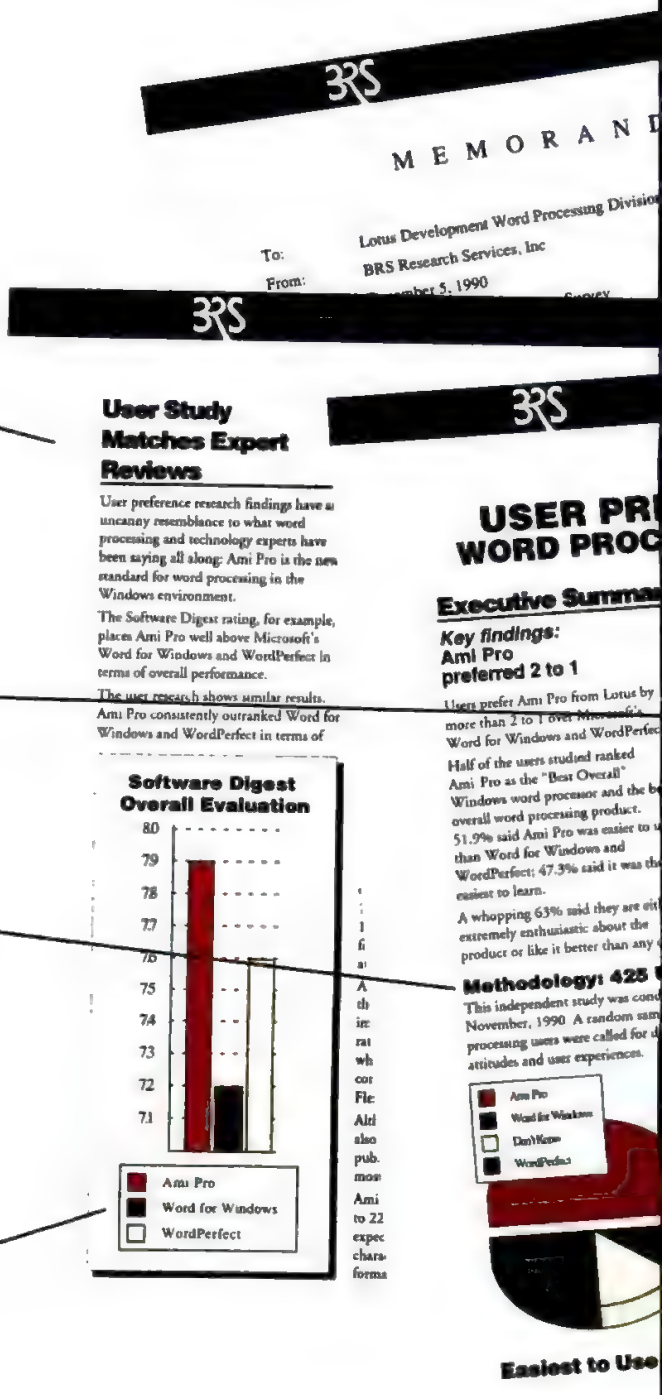
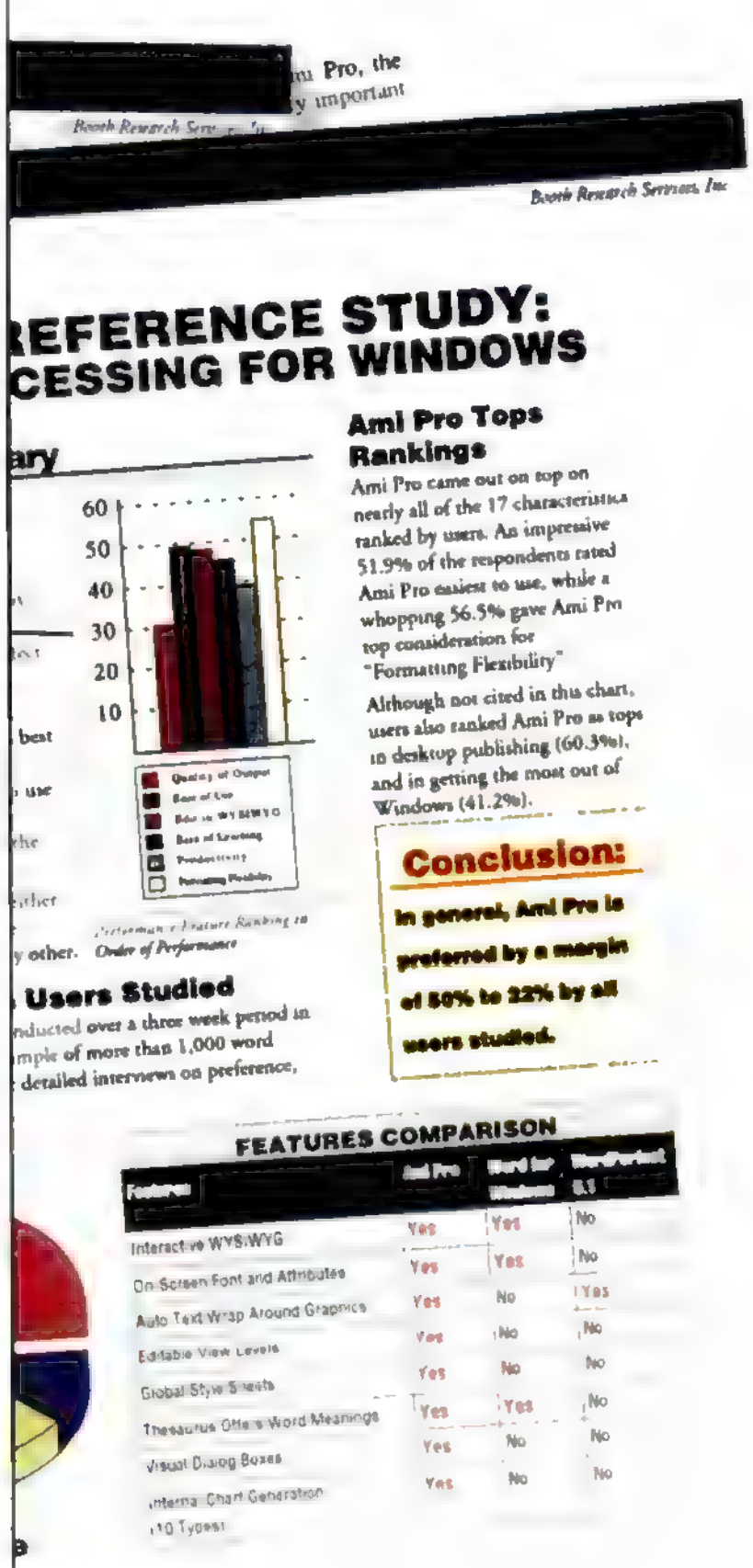


*Study results and complete questionnaire available by writing Booth Research Services, Inc., 1120 Hope Road, Suite 200, Atlanta, GA 30350. Enclose $100 plus $3.00 shipping and handling.

ey're saying it.

D U M



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It's easy to see why users prefer Ami Pro from Lotus two to one over Microsoft® Word for Windows™ for overall features and ease of use. And why it's received top ratings from virtually all the industry experts, racking up such coveted awards as PC World's Best Buy. The Buyers Assurance Seal from InfoWorld. And PC Magazine's Editor's Choice.

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Customizable Icon Bar
• Choose From Over 45 Functions • Quick Access to Features
Customizable View Level
• 10-400% • Fully Editable
Cut and Paste
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• Today's Date • Date Printed • Date Last Edited • Definable Style
DDE (Dynamic Data Exchange)
• Two-way • Paste Link • Text and Graphics • Via Macro Language
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• Backup Options • Date Styles • Dictionary Paths • Display Options • Document Path • Draft Mode Colors • Footnote Options • Hyphenation Hot Zone • Pair Kerning • Printer • Icon Bar Icons • Undo Levels • View Level
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Document Annotation
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Section Outline Numbering
• 6 Levels • Number Paragraphs • Numbered Lists • User-Defined Reset
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File-Transfer SOFTWARE

by Frank J. Derfler, Jr.

Low-priced and easy to use, file-transfer software programs provide a quick and efficient way to transfer files between portables and desktop machines. And some even offer ways to use an attached PC's drives and printer.

All portable PCs are not created equal. For instance, many laptops don't have the ability to accept an internal network adapter, and some, like the NEC UltraLite, don't come with a floppy disk drive as standard equipment. Even when your portable does include a 3.5-inch floppy disk drive, it's likely that your desktop PC still uses 5.25-inch disks.

It's vital that users be able to move information from their portable traveling companions to their desktop systems (and vice versa) quickly and efficiently. One of the most inexpensive and effective solutions is file-transfer software. The file-transfer products we review here—Fifth Generation Systems' *The Brooklyn Bridge*, ConnectWorks' *ChainLink*, Micro-Z's *DirecLink*, Rupp's *FastLynx*, GetC's *File Shuttle Xpress*, Cyco's *The Flying Dutchman*, Datastorm's *Hot Wire*, Traveling Software's *LapLink III*, and Intertech's *Rapid Transfer Easy*—provide a simple one-to-one link between any two DOS-based computers. *File Shuttle Xpress* is even optimized to run under the *Microsoft Windows* environment. (By the time you read this feature, it should be facing competition from Traveling Software's *Windows*-based *WinConnect*, which was scheduled to be shipped sometime in late January.)

GRAPHIC: MICHAEL GRAHAM

Installing these products is a snap, generally requiring only 2 to 5 minutes. Some of them even helpfully install themselves on a remote device from the connected PC where they are already loaded. This is particularly useful when you want to transfer files to or from a laptop that doesn't have a floppy disk drive.

REVIEW CRITERIA

In this review, we cover file-transfer programs priced at or below $150. (*PC-Hookup*, from Brown Bag Software, met this criterion but did not arrive in time for us to review it.) Not only do these packages provide a simple way to move files between a portable PC and a desktop PC—or any two computers, for that matter—but some allow one of the machines to use a printer attached to the other. A few have the ability to give one PC access to the remote PC's local disks as virtual drives, and others let an attached PC use any network drives to which its counterpart has access.

File-transfer programs typically run as foreground applications, although *ChainLink*, for instance, does offer TSR capabilities. These products also typically offer bidirectional operation—that is, the roles of the local and remote PC can be switched without exiting the program, and resources can be shared in either direction.

These packages often combine file-transfer capabilities with directory management facilities. The programs generally offer the user menu options for file transfers and more-complex management tasks such as creating subdirectories on the remote PC. *The Brooklyn Bridge*, *Direc-Link*, *Rapid Transfer Easy*, and others also have advanced modes that allow you to enter file-transfer and other commands directly from the DOS command line.

COMMON FEATURES

Among the features common to all these packages are file overwrite protection and error detection. Nearly all the products we reviewed allow tagging a file or groups of files for transfer, and contain management-oriented features like sorting by name, extension, date, and size; renaming files; and creating, removing, or renaming directories and subdirectories. *The Flying Dutchman*, which emphasizes clean and simple file transfers, is an exception.

Several packages include the ability to run macros or scripts. Connect the cables and start the programs up on each machine, and they will follow instructions: for instance, automatically transferring specifically named files.

Most of the packages include the cables needed to connect with the PCs' parallel or serial ports, although not all offer both types of connections. Some companies provide all-purpose parallel/serial cables with three connectors at each end—the female 25-pin chassis connectors used for parallel ports, and the male 9- and 25-pin chassis connectors used for serial ports—while others supply separate parallel and serial cables.

A number of the portables we review in this issue provide file-transfer facilities as standard equipment.

Our advice is to label the cables! Once they're jammed into a drawer with other similar cables, you may have a frustrating experience picking them out of the crowd when it comes time for your next file-transfer task. Rupp Corp. and Traveling Software deserve praise for supplying cables specifying both their use and the company name.

One common complaint about file-transfer programs is that while they are simple to operate, they often provide confusing interfaces (see the sidebar "File-Transfer Interfaces: Where Do We Go from Here?"). And don't expect them to be able to talk to one another; a PC running *Direc-Link* won't hook up to one using *Rapid Transfer Easy*. There is simply no standard for communications between any two of these programs.

LINKING OPTIONS

A number of the portables we review in this issue provide file-transfer facilities as standard equipment—the Dauphin 2000SX, Sharp PC-6220, and Texas Instruments T2000 come equipped with *LapLink;* and Dataworld's Portacomp 386 offers *FastLynx*. File-transfer options have also found their way into DOS shells like *The Norton Commander*, which incorporates a proprietary scheme, and into utilities like *PC Tools*, Version 6.0 (its

EDITORS' CHOICE

• FastLynx

This is a close horse race. In all cases, these file-transfer packages install quickly and provide a real service to their users. The leading programs in the file-transfer software category compete neck and neck, matching each other nearly feature for feature, not to mention dollar for dollar. In particular, *The Brooklyn Bridge*, *FastLynx*, and *LapLink III* are all safe bets for anyone looking for file-transfer products. (In various versions, *LapLink* is already standard equipment on many vendors' portable offerings.)

FastLynx from Rupp Corp. beats its competitors by a nose. We're giving it the Editors' Choice because it provided the best throughput during file-transfer tests, clearly outrunning every other product we reviewed. Like several of the other packages, *FastLynx* offers a remote-install (or autocloning) feature that allows you to set up the program on laptop PCs that lack floppy disk drives. And like many of the packages, *FastLynx* provides a convenient split-screen mode that makes it easy to select the files or directories you wish to copy. It also offers a Form mode for creating macros to automate file transfers, and a DOS-command-line user interface. And like *The Brooklyn Bridge* and *Laplink III*, but unlike many of its competitors, *FastLynx* can let a remote PC redirect virtual drives to the source PC; it can also use network printers attached to that machine.

With its laundry list of features and its speedy throughput times, *FastLynx* provides a complete file-transfer option—as red-hot as the brightly colored cables that accompany the software.

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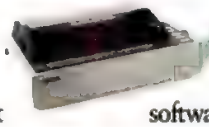

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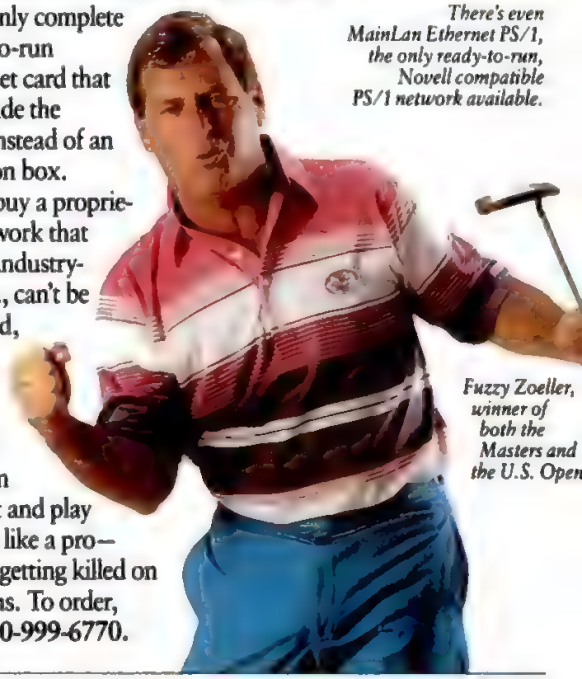

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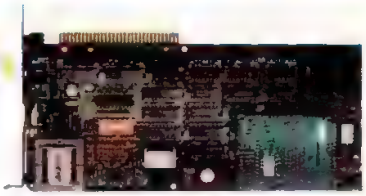

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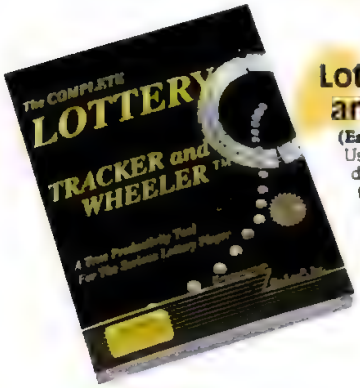

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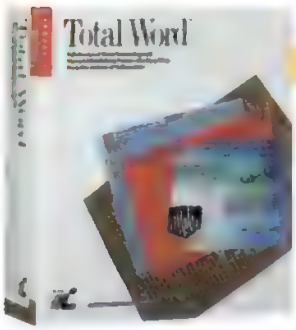

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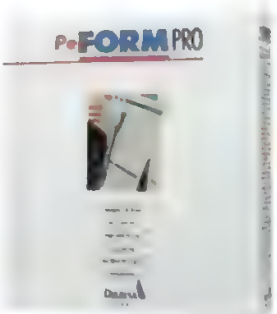

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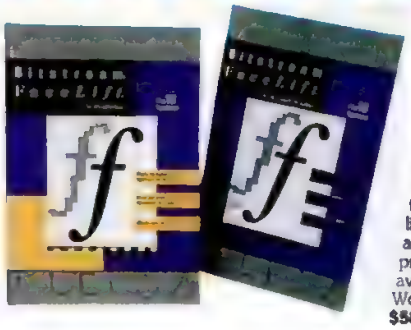

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In lieu of the one-on-one links these file-transfer packages provide, users can connect their PCs by using modem remote-control packages, zero-slot LANs, or network connections.

For instance, you can use your laptop's modem to call either a standalone or networked PC, and take advantage of products like *Blast RemoteControl*, *Close-Up*, *CoISession*, or *Remote*^{2} to control the called (or host) PC's actions. In addition to running applications on the host PC, these modem remote-control programs let you transfer files and send print jobs to called systems. They provide a fine way to link portables or other machines to your office PC when you're away, and they also work when you bring the laptop computer to the desktop. Typically, they have an option for direct connection to a local PC through an RS-232C cable.

These programs are indispensible for users who transfer data from one PC to another.

On the other hand, these programs require special null-modem cables (with the second and third pins swapped) for the local connection, and they are overkill for people who don't need long-range laptop-to-desktop connections. (Complete packages generally cost between $200 and $450.) Also, since these products are limited to using serial port connections, their throughput suffers in comparison with other options.

Zero-slot LANs, such as Artisoft's *LANtastic/Z* and Traveling Software's *DeskLink* (see "Zero-Slot LANs," *PC Magazine*, April 24, 1990), provide more options than file-transfer programs, but they're more complex to install and use, and their special drivers take up to 143K of RAM. Also, they are intended as permanent installations of two workstations.

PORTABLES ON LANS

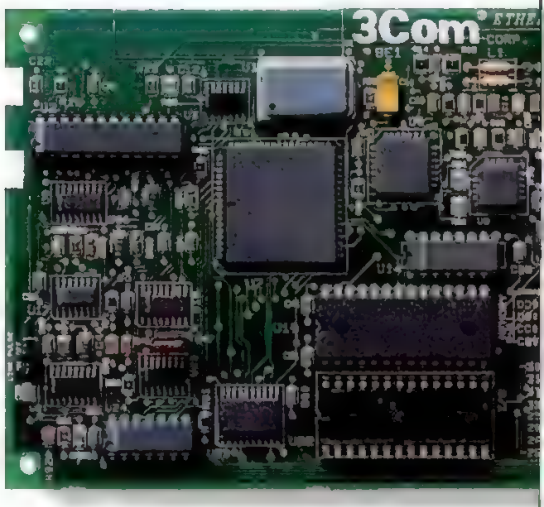
A LAN connection can provide a portable with fast throughput and access to many resources. Some portables can host internal network adapters, but you can also connect practically any portable or desktop machine to a network using external LAN adapters such as those from D-Link, IQ Technologies, and Xircom. (See "Portable LAN Adapters," January 15, 1990.) These connect to the parallel port and provide performance that's good enough for all the networked applications you're likely to use. Through an external LAN adapter, your portable can provide an alphabet's worth of networked drives and access to any networked printers.

Of course, you've got to have a network installed to use an internal or external LAN adapter. A network connection is going to cost more than the price of a file-transfer program, and if your needs are limited to occasionally sharing files, disks, and printers, the expense might not be justified.

SPEED ISSUES

The speed you'll enjoy when transferring files between computers with the prod-

Oh, what a twis



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ucts reviewed here depends in large part on the type of connection you use and the CPU power of the slower PC in the pair. When you move data through the serial ports of a pair of PCs, each byte goes over the wire 1 bit at a time. Parallel port connections move a byte across the wire in 8 parallel bits. Our performance tests confirm that using parallel connections between PCs provides five to six times the throughput of serial connections.

Don't be confused by the speed settings available in these file-transfer programs. The menus typically let you select up to 115.2 kilobits per second (Kbps) for the serial ports. But that figure represents only the potential rate of change of the signals over the wire. Many other factors, particularly the source of the data, limit the actual throughput rate during the data exchange. Serial port throughput rates of 20 to 80 Kbps are typical with most 80286 machines. The parallel port connection will move data at rates of 90 to 140 Kbps.

The tradeoff for the parallel port's greater speed comes in the maximum distance between the connected PCs, as well as in the availability of a port. While the serial connection might be useful over several hundred feet, the limit of the parallel connection is generally 20 to 50 feet. (Companies' distance recommendations for serial ports are contingent on the signaling speed of the ports, the type of cable used, and the electrical environment around the cable.) Yet there aren't many applications where distance would be a factor in the use of these programs, since you generally must use both keyboards to start and stop the software.

The companies represented here have not yet come out with multiplexers to allow shared use of a parallel port. If you want to share a printer attached to a machine's only parallel port, you'll need to use a serial connection, which means slower throughput.

Whether you prefer to connect over parallel or serial ports, these file-transfer programs are practically indispensible for any user who must transfer data from one PC to another, and that means portable owners in particular. Whether you have a floppy disk drive incompatibility or a laptop with no disk drive at all, you would do well to give one of these inexpensive and easy-to-use products a permanent place on your software shelf.

The Brooklyn Bridge

by Kimberly Maxwell

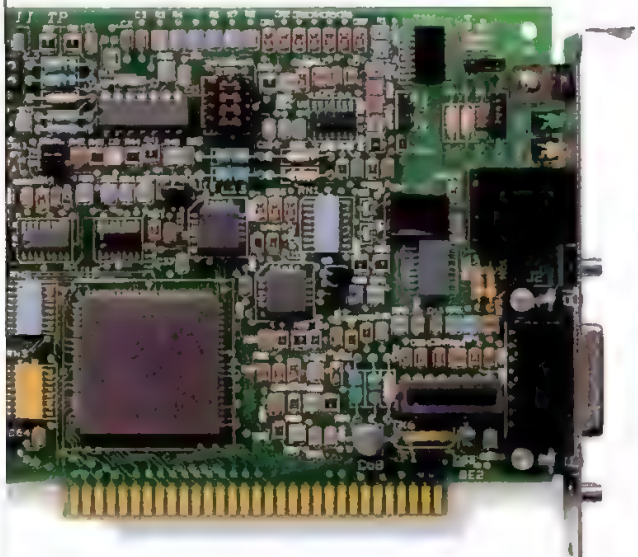
Neither Rome nor most bridges were built in a day, unless you're talking about *The Brooklyn Bridge*, Version 3.0, from Fifth Generation Systems. Within minutes, you can hook up this $139.95 bridge and link two PCs for file transfers, printer sharing, and real-time chatting. One of the original entries in the file-transfer software market, the program also offers a wide choice of file-management options from its menu and command line interfaces.

The package includes both 5.25- and 3.5-inch disks, a parallel cable, and a two-headed serial cable with both 9- and 25-pin connectors. If you use the parallel mode, you will get a much faster transfer rate—up to 500,000 bits per second (*The Brooklyn Bridge* performed near the top of the pack on both of our parallel-connections performance tests). The serial mode provides a maximum file-transfer rate of 115,200 bps.

TWO-IN-ONE PACKAGING

The Brooklyn Bridge really contains two programs in one. You can use a command

ted life it leads.



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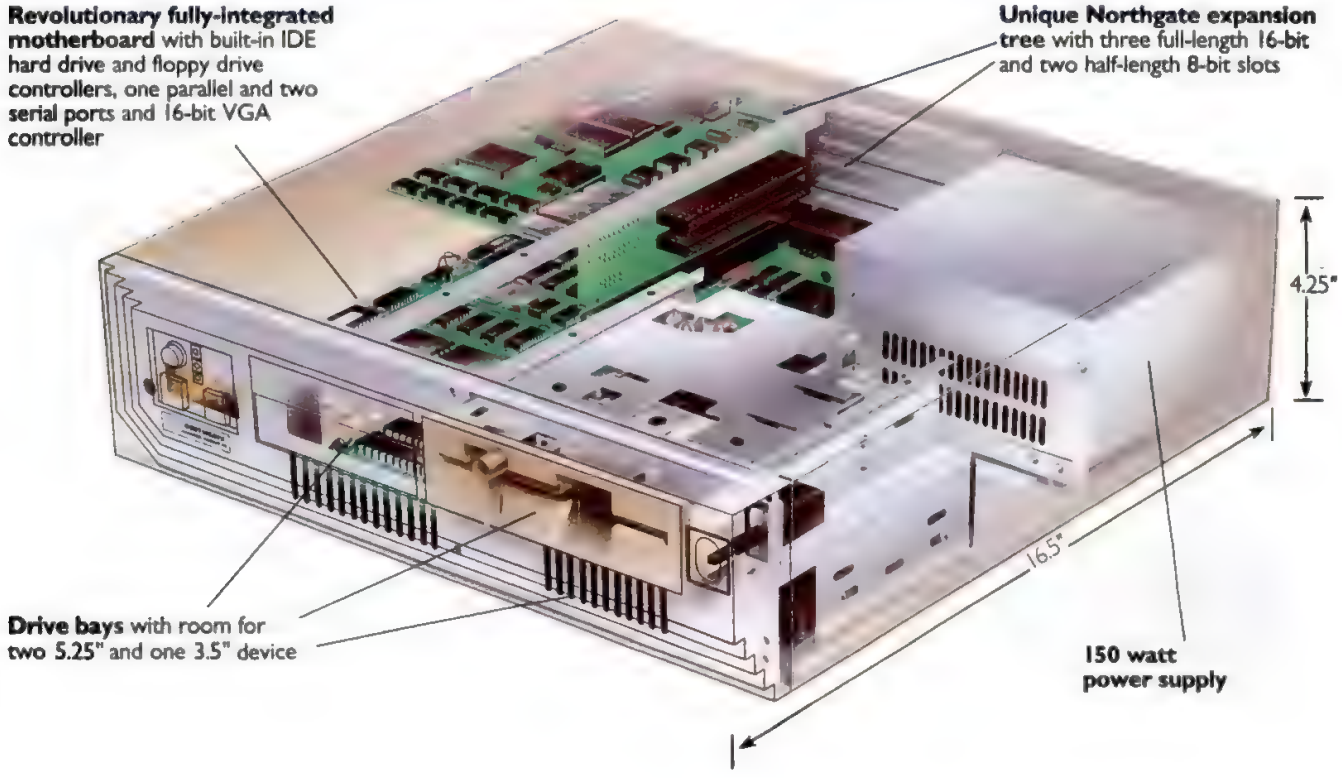

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line method or a menu-driven program called Filer. The menu method takes 190K RAM in each PC, while the DOS command line mode requires only 64K to 75K. The two methods offer similar capabilities but follow different approaches.

The command line option lets you use DOS-like commands to perform tasks such as transferring files and running programs from the remote PC's hard disk. *The Brooklyn Bridge* lets the remote machine's hard disk act as a virtual drive for the local PC; the remote PC's files, for instance, can be treated as additional files on the local machine. Command line mode also lets you access remote printers, network drives, or other devices, but you must make sure they're listed in your CONFIG.SYS file.

Command line mode is a bit more difficult to set up and operate than the Filer menu system. Filer provides a lazy man's way to automate the program quickly. Filer can also help you clone *The Brooklyn Bridge* to a second machine.

Filer's menu interface feels much like *Lotus 1-2-3*'s. You access the main menu bar with the slash key and move through menu bars with cursor keys. While the interface is familiar and not very difficult to use, pull-down menus would be a more modern alternative.

The Filer menus provide access to over 175 file-management and -transfer utilities. Filer displays a split screen, showing local files, remote files, and directory trees. You can copy, move, or erase single files or tagged groups on both machines, or select the WildMark option to mark a group of files by wildcard. An on-screen percentage figure monitors the progress of the transfer.

You can define up to five application programs to run from within Filer. However, you can load only programs that originate on the local PC. Unlike the command line mode, Filer cannot run a program or load a data file from the remote PC's drive.

The program's chat feature allows users at the two machines to exchange real-time messages. You can also define shortcut keys that function like macros to automate a particular action.

Fifth Generation Systems offers free support weekdays with a toll number. With sophisticated file-management utilities and useful file-transfer capabilities, *The Brooklyn Bridge* is a dependable choice at a fair price. You won't go wrong using this product as your file-transfer solution.

FACT FILE

***The Brooklyn Bridge*, Version 3.0**
Fifth Generation Systems Inc., 10049 N. Reiger Rd., Baton Rouge, LA 70809; 800-873-4384, 504-291-7221.
List Price: With 5.25- and 3.5-inch disks, parallel and serial cables, $139.95.
Requires: 75K RAM for command line mode, 190K RAM for Filer program, DOS 2.1 or later, serial or parallel port on each PC.
In Short: In the command line mode, *The Brooklyn Bridge* provides virtual drives and access to a remote PC's printers. The Filer menu-driven software won't run a program or load a file from a remote PC's drive, but you can define up to five application programs to run directly from the local drive. A wide choice of options make for sophisticated file management and file transfers.

CIRCLE 410 ON READER SERVICE CARD

ChainLink

by Sara Parker

Are you looking for an easy-to-use file-transfer system with plenty of bells and whistles? *ChainLink*, Version 1.21, by ConnectWorks Co. is just the ticket.

Priced at $99 for a two-user package, *ChainLink* offers an intuitive interface with pull-down menus and mouse support. The company claims that it can connect PCs up to 2,000 feet apart on a serial link (of course, that's a longer stretch than in most simple two-user file-transfer connections). Despite some limitations, *ChainLink* gives you great freedom and flexibility when sharing information. The program offers sophisticated security measures, the ability to operate in TSR mode, and a chat mode; upgraded versions let you link up to 16 machines.

ChainLink doesn't include a parallel-connection scheme, but ConnectWorks gives you a cable for a serial connection and both 5.25- and 3.5-inch disks. The bad news is you will probably need both types of disks. The software does not clone itself onto the remote computer; you must manually install it on each computer you connect, so each PC must have a floppy disk drive.

If this doesn't present a problem, installation is certainly easy enough. You plug the package's cable into the serial ports of both computers, insert the disk into the local computer, and type INSTALL at the prompt. The files will automatically copy onto the drive you specify. Follow the on-screen instructions, repeat the process for your remote computer, and you're ready to share files.

ChainLink offers a lot of options on its menus. The split-screen interface lets you view the files on the local PC simultaneously with files on the remote computer. In chat mode, you can send and receive messages and carry on a running dialog with another connected PC. You can execute DOS commands such as COPY and ERASE without ever exiting *ChainLink*. And if you turn on the Erase menu's Verify option, you have the opportunity to back out of erasing a file if you decide to keep it.

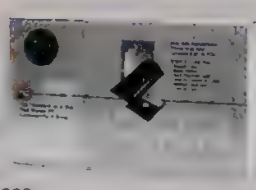
Along with this safety provision, ConnectWorks supplies an important feature sorely lacking in many packages: security. Its Remote Access feature permits four levels of access, ranging from full access to denied access.

LINKING 16 PCS

The security measure becomes especially important when linking more than two PCs. If you don't have a LAN available, higher-priced versions of *ChainLink* allow up to 16 computers to be connected at your site. ConnectWorks supplies a box-like device for connecting more than two PCs at a time.

FACT FILE

***ChainLink*, Version 1.21**
ConnectWorks Co., P.O. Box 497, Wrightsville Beach, NC 28480; 800-992-5465, 919-256-2366.
List Price: With 5 25- and 3.5-inch disks, four-line telephone cable for serial connection, $99.
Requires: 256K RAM, DOS 3.1 or later, 600K hard disk space and serial port on each PC.
In Short: A low-cost file-transfer system, *ChainLink* has a host of built-in bells and whistles. It won't clone itself onto a remote PC, but it does provide security measures, a chat mode, longer-distance link-ups, and mouse support. Upgraded versions that allow you to connect up to 16 PCs at your site are available.



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The company offers a one-year warranty on all its cables and hardware devices, along with free technical support weekdays at a toll-free number. If you need to link PCs that aren't physically close and require the ability to send files and messages, *ChainLink* offers an inexpensive solution. But if you simply want to link your portable PC to your desktop PC—and you want to do it quickly—the product's generally lackluster scores on our serial-port connections performance tests, as well as its lack of parallel-port support for higher-speed connections, may force you to look elsewhere.

Direc-Link

by Lisa Cady Newell

It's billed as "the perfect link between laptops and desktops." The truth is that Micro-Z's *Direc-Link*, Version 3.1, offers a good if not perfect option for anyone who needs efficient data-transfer capability between two workstations. The software retails for $59.50; for additional serial cabling and a parallel adapter, add another $45. In addition to file-transfer capabilities, the program provides expected options like error detection, overwrite protection, and sortable directory-tree displays of both stations.

Direc-Link comes with only software and documentation. If you need cabling, Micro-Z can also sell you a parallel cable adapter and a set of cables offering 9- and 25-pin male and female connectors that should accommodate any combination of serial ports. Micro-Z recommends that you use a serial cable for data transfers over 50 feet to ensure reliable data transmission.

FLEXIBLE STARTUP OPTIONS

You can access the program through its on-screen menus or by a DOS prompt that accepts script files to save time on routine transfers. If you opt for the easy-to-use menus, you can color-customize them.

A touch of the ScrollLock key puts your keyboard in parallel with the other station's, effectively giving you remote control over its operations. Using *Direc-Link*, you can transfer entire disk structures and subdirectories, rename them, delete them, or view the files in hex or text mode.

We installed *Direc-Link* quickly at PC Magazine LAN Labs, using the program's port and cable tests to ensure we had our serial connections straight. The manual advises you to customize the CONFIG .SYS file by adding a BUFFERS statement, thus increasing the amount of space available for large files and speeding up the transfers.

Direc-Link offers an Autoclone feature that lets you install it on another machine over serial cable. This is particularly helpful when you need to transfer data into an associate's computer from your portable but don't have the program disks available or lack a floppy disk drive on the remote machine.

Since Micro-Z also makes *Direc-Tree Plus*, it should come as no surprise that *Direc-Link* scans and diagrams the disk with a tree display upon initialization. Later, you can opt to skip the function to save time. You can also view the file directories in a split-screen display. Files can be sorted by name, extension, size, or date, in ascending or descending order.

Since no acknowledgement of transferred files comes back from the receiving PC, you may have to scan the directory to verify whether the transfer was successful. When you transfer a file containing over 200 bytes, a thermometer icon pops up to show the percent transmitted. *Direc-Link* has the advantage of offering the speedier parallel connection option, but it transferred the fewest bits per second on our parallel transfer performance tests.

Micro-Z provides helpful documentation and technical support via a toll-free number, or on-line through Prodigy and CompuServe.

Direc-Link benefits from a good number of features, including autocloning, testing of port connections, and color-customizable screen displays. Not least among its attractions are its low price and technical-support options, which may make it attractive for users on a budget and for novices.

FACT FILE

***Direc-Link*, Version 3.1**
Micro-Z Co., 4 Santa Bella Rd., Rolling Hills Estates, CA 90274; or 800-755-3553, 213-377-1640
List Price: With 5.25- and 3.5-inch disks, $59.50. Parallel cable adapter (for use with any parallel printer cable) and serial cables, $45.
Requires: 35K-45K RAM, DOS 2.0 or later; parallel or serial port on each PC.
In Short: Ease of use and low price are the hallmarks of *Direc-Link*. Error detection, overwrite protection, sortable directory tree displays for both PCs, and other features contribute to efficient, reliable management and transfer operations.

CIRCLE 412 ON READER SERVICE CARD

FastLynx

by Sara Parker

Some companies like to take the literal approach when naming their products. That's certainly the case with Rupp Corp.'s *FastLynx*, Version 1.1. The $149.95 package links PCs and transfers their files at high speeds. *FastLynx* took top scores across the board on our parallel- and serial-connection file-transfer performance tests. Additionally, the software provides a versatile choice of interfaces and gives small installations an inexpensive alternative to a local area network, with support for virtual drives and network printer-sharing.

You don't have to worry about the *FastLynx* cables getting lost in the shuffle, either; they're bright red and clearly marked with the name Rupp. The four-headed serial cable adds to *FastLynx*'s overall ease of use. Rupp also bundles a two-headed parallel cable with the package. Both cables are 8 feet in length. The package also includes both 5.25- and 3.5-inch disks.

Installing the program takes less than 5 minutes. To transfer files from a desktop computer to a laptop computer (or any two PCs), you connect their two ports, either serial to serial or parallel to parallel. You can install the program on the hard disk of the desktop computer, for example, and then clone *FastLynx* to your portable PC. Since you don't need a disk drive on the remote PC, the program works with laptops like the NEC UltraLite, which don't come standard with floppy disk drives.

THREE OPERATIONAL MODES

Once *FastLynx* is up and running, you can choose from three modes of operation: split screen, form, and command line. Split-screen mode lists the local drives on the left side of the screen and the remote drives on the right. (It would be better if

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FILE-TRANSFER SOFTWARE: SUMMARY OF FEATURES

Products listed in ascending price order

	Direc-Link	Rapid Transfer Easy	ChainLink	The Flying Dutchman	Hot Wire	The Brooklyn Bridge
List price	$59.50	$69.95	$99.00	$99.00	$129.00	$139.95
Cables or adapters included	❑	■	■	■	■	■
Type	N/A	Serial cable	Serial cable	Parallel cable	Serial cable	Parallel and serial cables
SUPPORTED PORTS						
Supports parallel-port connections	■	❑	❑	■	❑	■
Maximum recommended distance	50 feet	N/A	N/A	50 feet	N/A	15 to 20 feet
Supports serial-port connections	■	■	■	❑	■	■
Maximum recommended distance	300 to 500 feet	50 feet	2,000 feet	N/A	50 to 75 feet	150 feet
Automatically senses ports used	❑	■	❑	■	❑	■
INTERFACE						
Bidirectional control	■	■	■	■	❑	■
Menu-driven interface	■	■	■	■	■	■
DOS command-line interface	■	■	❑	❑	❑	■
Split-screen display of local and remote PCs	■	❑	■	❑	■	■
"Tree" display of directories	■	■	■	❑	■	■
FILE SELECTION						
By wildcards	■	■	■	■	■	■
By date	■	❑	■	❑	■	❑
By subdirectory	■	■	■	■	■	■
By directory branch	■	■	❑	■	■	■
By entire logical drive	■	■	❑	■	■	■
Files modified since last transfer	■	■	■	❑	■	■
FILE MANAGEMENT						
Sorts files in ascending or descending order	■	❑	❑	❑	■	■
Changes file creation date and time	❑	❑	❑	❑	■	■
Changes DOS attributes	❑	❑	❑	❑	■	■
OPERATION						
Automated file transfers	■	■	❑	■	■	■
Background file transfers	❑	❑	■	❑	❑	❑
Files transferred by modem	❑	❑	❑	❑	■	❑
On-screen indicator of file-transfer progress	■	❑	■	■	■	■
Built-in file viewer	■	■	■	❑	■	■
Virtual drive capabilities	❑	❑	❑	❑	❑	■
Can access remote PC's local printer	■	❑	■	❑	❑	■
Can access remote PC's networked printers	■	❑	❑	❑	❑	■
Auto-cloning feature	■	❑	❑	❑	❑	■
Chat utility	❑	❑	■	❑	❑	■
Context-sensitive help	■	❑	■	■	■	■
TECHNICAL SUPPORT						
Toll-free number	■	❑	■	❑	❑	❑
Hours (A.M.–P.M.)	9:00–5:00 M–F (P.S.T.)	9:00–6:00 M–F (E.S.T.)	9:00–5:00 M–F (E.S.T.)	9:00–5:00 M–F (E.S.T.)	9:00–5:00 M–F (C.S.T.)	7:00–7:00 M–F (C.S.T.)

—Editors' Choice ■—Yes ❑—No
N/A—Not applicable: The product does not have this feature.

	File Shuttle Xpress	FastLynx	LapLink III
	$139.95	$149.95	$149.95
	■ Rocket Socket parallel adapter	■ Parallel and serial cables	■ Parallel/serial cables
	■ 100 feet ■ 300 feet ❑	■ 100 feet ■ 100 feet ■ (local port)	■ 20 feet ■ 100 feet ❑
	■ ■ ■ ❑ ■	■ ■ ■ ■ ❑	■ ■ ■ ■ ■
	■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■
	■ (under *Windows*) ❑ ■	■ ❑ ❑	■ ❑ ❑
	■ ■ ❑ ■ ■ ❑ ❑ ■ ❑ ■	■ ❑ ■ ❑ ■ ■ ■ ❑ ■ ❑	■ ❑ ■ ❑ ■ ■ ■ ❑ ■ ❑
	■ 9:00–5:00 M–F (P.S.T.)	❑ 8:00–5:00 M–F (M.S.T.)	❑ 8:00–5:00 M–F (P.S.T.)

the source and destination drives were also labeled.) Point-and-shoot menus make it the easiest of the three modes to use. You can transfer single files or whole directories with a single keystroke. As *FastLynx* moves the files, it displays the percentage already transferred.

Form mode helps you create macros to automate requests between the local and remote computers, making repeatable tasks like file backups and transfers of specific files easier.

Command line mode resembles DOS's copy and delete operations (among others), but in this case the commands can work across both local and remote drives. A word of caution, though: All remote commands must be prefaced with a DO command. If you want to delete a group of files on the remote machine and forget to include DO, you may inadvertently delete files on your local drive.

TRUE LAN

A feature called EBOX provides *FastLynx* with the ability to operate like a true LAN, at the cost of 200K RAM in the remote machine. EBOX can support a virtual drive connection, allowing, for example, a laptop PC's hard disk to access a desktop PC's larger hard disk and run its selection of programs as if they were its own. If the desktop PC is connected to a real network operating system, *FastLynx* won't give the laptop access to the network server's drives, but it will let the laptop use a network printer.

FACT FILE
EDITORS' CHOICE

***FastLynx*, Version 1.1**
Rupp Corp., 835 Madison Ave., New York, NY 10021, 800-852-7877, 212-517-7775.
List Price: With 5 25- and 3.5-inch disks, parallel and serial cables, $149.95.
Requires: 190K RAM, DOS 2.0 or later; parallel or serial port on each PC.
In Short: *FastLynx* is simple enough for the novice, yet powerful enough for the professional. It covers all the bases with its three user interfaces—split-screen, form, and command mode. A feature called EBOX provides virtual drive abilities, plus the ability to use a networked printer with a remote PC attached. Its distinctive red cables are another plus.

CIRCLE #13 ON READER SERVICE CARD

Rupp's documentation is concise and almost unnecessary if you take advantage of the good context-sensitive help and online reference guide. If you have any problems, Rupp offers free technical support on weekdays at a toll number for *FastLynx*.

FastLynx is a proven product that's easy to install and use. The flexibility of the user interfaces provides room for growth and allows you to transfer your data any way you like. That is, as long as you like it fast!

File Shuttle Xpress

by Lisa Cady Newell

GetC Software's *File Shuttle Xpress*, Version 5.0, is a $139.95 package that provides both a character-based and *Microsoft Windows* interface. Additionally, it delivers options like a text editor and global file-attribute modification. It can also create macros to speed execution of time-consuming functions.

File Shuttle Xpress shines under *Windows*. The *Windows* mode includes easy-to-use pull-down menus and makes scrolling through directories simple. You can transfer files between two PCs running *Windows*, or between one PC running *File Shuttle Xpress* under *Windows* and one running it under DOS. On the *Windows* side, if you select the automatic reception mode, you can minimize the program so that it appears as only an icon but remains active for file transfers. When the operator of the attached PC initiates a transfer, a screen pops up displaying a bar graph showing the transfer time.

Although much of the appeal of *File Shuttle Xpress* is to *Windows* users, those who run only DOS will also find this program quite manageable. Separate manuals detail the software's abilities in each environment.

Under DOS, the program was one of the fastest we reviewed in the parallel-connection mode. The *Windows* environment does slow down file transfers. Under *Windows*, it lost roughly 100 bits per second of throughput in the parallel mode, but it was still faster under *Windows* in parallel mode than some other programs were under DOS. (When attached by serial ports, however, it came in at the low end in both DOS and *Windows* modes.)

Instead of supplying cables, GetC offers a device called the Rocket Socket.

PERFORMANCE TESTS: FILE-TRANSFER SOFTWARE

Using parallel connections to hook up two PCs for file-transfer duties will always provide faster throughput than serial connections—often five or six times as fast. Our tests also show that across the board, the results of compressible file transfers did not differ much from those of random file transfers.

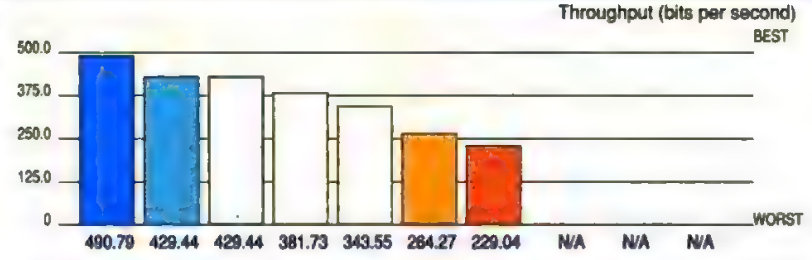
For these tests, we used a Dell System 200 with an 80286 processor running at 10 MHz and a Unisys PW² running an 80386 processor at 33 MHz. Although we used desktop PCs at both ends, you could expect comparable throughput on a portable computer equipped with enough RAM to install a 4MB RAM disk.

We ran **Random File** and **Compressible File** versions of the **File Transfer** test using both parallel and serial connections. These measure throughput on PC-to-PC file transfers across parallel and serial cables. We established 4MB RAM disks on both a 286-based PC and a 386-based PC. Next we loaded the RAM disks with a 3MB file containing compressible data, and with a 500K file containing random data that does not lend itself to compressing.

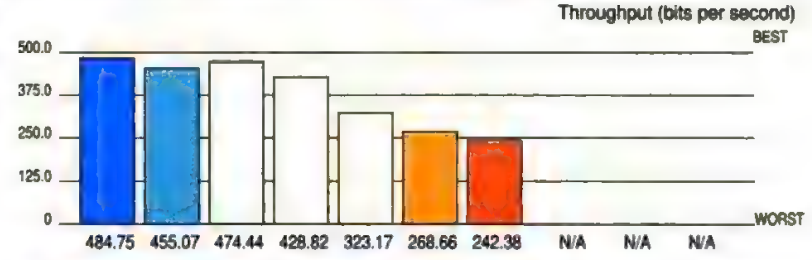
We then transferred the files from the RAM disk of the 286 computer to the RAM disk of the 386 computer using all available connection options. We timed the transfer and converted the results to determine the throughput rate in bits per second.

FILE TRANSFER

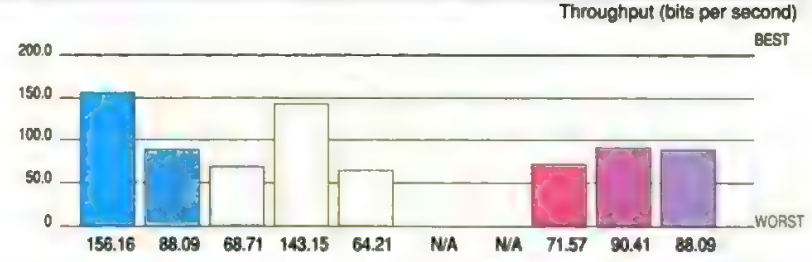
Random File (Parallel Connections)



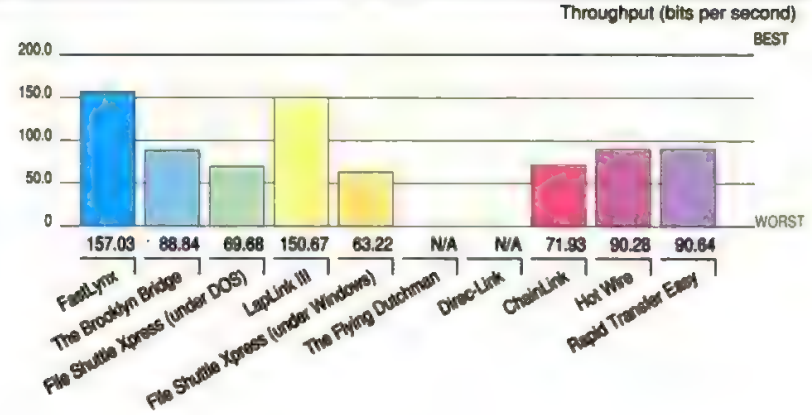
Compressible File (Parallel Connections)



Random File (Serial Connections)



Compressible File (Serial Connections)

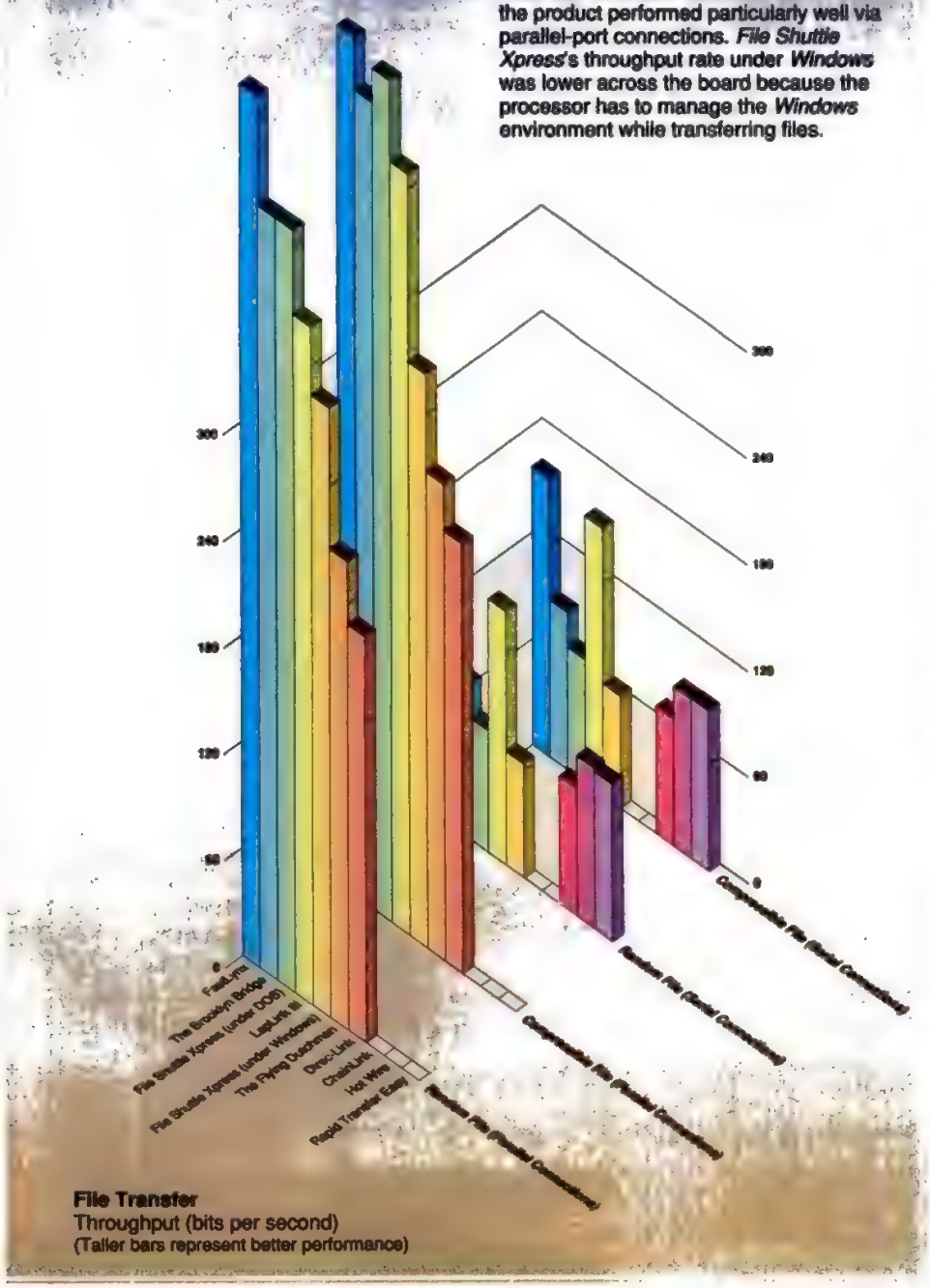


N/A—Not applicable: The package did not perform this test.

We tested these products with both parallel and serial connections whenever possible. *ChainLink*, *Hot Wire*, and *Rapid Transfer Easy* do not provide for parallel connections; *The Flying Dutchman* does not support serial connections. *Direc-Link* can transfer files using both parallel and serial connections, but although the serial connection scheme worked well on small files, it aborted when trying to transfer our test files of 500K and 3MB.

Parallel connections are always faster than serial connections, often five or six times as fast. Clearly, connecting two computers via their parallel ports is the desired mode of operation when speed is the issue. Serial connections, however, are handy in that they are generally useful over longer distances (several hundred feet).

FastLynx didn't appear to use file compression, but it clearly beat every other product on every throughput test. Other veteran programs like *The Brooklyn Bridge* and *LapLink III* upheld their performance traditions. We are reporting throughput rates for *File Shuttle Xpress* under both DOS and *Microsoft Windows*; under DOS, the product performed particularly well via parallel-port connections. *File Shuttle Xpress*'s throughput rate under *Windows* was lower across the board because the processor has to manage the *Windows* environment while transferring files.



File Transfer
Throughput (bits per second)
(Taller bars represent better performance)

FACT FILE

***File Shuttle Xpress*, Version 5.0**
GetC Software Inc., Box 8110-182, 264 H St., Blaine, WA 98230-8110; 800-663-8066, 604-684-3230.
List Price: With 5.25- and 3.5-inch disks, Rocket Socket parallel adapter, $139.95.
Requires: 256K RAM with DOS 2.0, or 640K RAM with 256K extended memory under *Windows* 3.0; serial cable; parallel or serial port on each PC.
In Short: One of the few file-transfer packages optimized for *Windows*, *File Shuttle Xpress* is also available to all DOS users. It lets you create macros to speed execution of time-consuming functions, change file attributes globally to prevent overwrite or access by an unauthorized system user, and consult a tree-structured directory display. Its documentation could use work.

CIRCLE 414 ON READER SERVICE CARD

The Rocket Socket mates with an ordinary parallel cable, so you can use a standard printer cable with a Centronix plug on one end to link your PCs together. GetC recommends using a parallel connection for transfers up to 100 feet, although the product will also support serial connections.

FILE MANAGEMENT FUNCTIONALITY

The biggest drawback to this package is that you can't see a directory of files on the PC that's attached. Directory Prune and Graft menu options help you maintain a tree-structured directory display on the source PC (whether desktop or laptop), while you add and subtract subdirectories on it and designate graft directories for the target PC.

File Shuttle Xpress's file management capabilities are easy to use, yet powerful. You can select files using wildcard characters or within a specified date range, update files modified since the last transfer, or move around in a line editor that offers word processor–like operations. The package also provides a safety feature. You can globally substitute file attributes, such as read only and hidden, to prevent overwriting or access by an unauthorized user.

Function keys help simplify *File Shuttle Xpress*'s interface under both DOS and *Windows*, but their values are not listed on the standard on-screen display. A keyboard template would save you from having to press the F1 help key continu-

ally or looking up the proper keys in the documentation.

One of this package's drawbacks is its poor documentation. In case you get stuck, technical support is available weekdays at a toll number. While many people will regard the lack of a directory display for the connected station as a significant limitation, *File Shuttle Xpress* will charm *Windows* users, in particular, with its slick GUI interface and fast operation in parallel mode.

The Flying Dutchman

by Lisa Cady Newell

Cyco International is a Dutch corporation best known for *AutoManager* and *AutoSave*, its ventures into the *AutoCAD* add-on arena for organizing and restoring CAD files. The company also offers a $99 file-transfer product, *The Flying Dutchman*, Version 4.1, which it claims moves files at speeds of 280,000 bits per second, or 20MB in 14 minutes, over a parallel cable. While in parallel mode, *The Flying Dutchman* outpaced only one of the other file-transfer products we reviewed. It's as easy to use as a file-transfer package can be and less expensive than most.

Since you only get one menu without too many options, you don't spend much time customizing it. You can use *The Flying Dutchman*'s simple on-screen menu to transfer data interactively, or using an automated batch file transfer, you can set it and forget it when transferring entire disks or directories.

This file-transfer package doesn't offer a serial option. It does, however, include Cyco's proprietary parallel cable and both 5.25- and 3.5-inch floppy disks. *The Flying Dutchman* doesn't include many fancy extras like an extensive file manager and on-screen customization, but it does offer one feature that will be particularly welcome to the legions of *WordPerfect* users: It shares the same

FACT FILE

***The Flying Dutchman*, Version 4.1**
Cyco International, 1908 Cliff Valley Way, Atlanta, GA 30329; 800-323-2926, 404-634-3302.
List Price: With 5.25- and 3.5-inch disks, parallel cable, $99.
Requires: 128K RAM, DOS 2.0 or later; parallel port on each PC.
In Short: Cyco's *The Flying Dutchman* isn't the fastest file-transfer package, and it provides neither extensive file management nor on-screen customization capabilities. Among its advantages are its ease of use, automatic batch-file transfer, and handy tests of your cable and port to diagnose problems when you can't make a connection.

CIRCLE 418 ON READER SERVICE CARD

FILE-TRANSFER INTERFACES: Where Do We Go from Here?

by Frank J. Derfler, Jr.

None of these programs make it complicated to transfer files from one PC to another, but sometimes their interfaces do introduce some confusion.

The screens shown here illustrate some of the common capabilities and limitations of file transfer software interfaces. The character-based programs— *Brooklyn Bridge*, *FastLynx*, *Hot Wire*, and *LapLink III*—provide a view of the files on the two connected PCs and allow you to tag files for transfer between systems, whether they're portables or desktop-based machines. Other common features include the ability to select files through a wildcard match, to perform an action on the unmarked files, and to shell out temporarily to DOS.

The complaint common to these interfaces is confusion over the local and remote directory screens. The problem is particularly acute when both subscreens are full of files and neither provides a strong visual clue as to which side of the screen represents which computer. It is interesting to compare these products with *File Shuttle Xpress*, which is optimized for operation under Microsoft *Windows*. It offers a sporty look, pull-down menus, and other catchy features, but its drawback is that you can't see a combined directory of files on local and remote computers.

The designers of the menu used in *The Brooklyn Bridge* attempted to clarify the distinction between the two PCs' files by providing source and destination labels, as well as remote and local tags. The source and destination labels change with the direction of the transfer. However, the initial screens (not shown here) for designating the direction of the transfer don't make the selection any easier.

Like *The Brooklyn Bridge*, *LapLink III* allows either PC to control the tasks. While *Laplink III* also labels the remote and local drives, notice how those labels sometimes just seem to get lost amidst the text-filled screen. An arrow showing the direction of the transfer would help.

function key values as both *WordPerfect* and *WordPerfect Library*.

FLYING BITS

To set up the program, you connect the cable to your workstation, install the software, select the transfer option from one PC's menu, choose the receive option on the other PC, and watch the bits go. You can easily transfer files, directories, directory trees with nested subdirectories, or entire hard disks to another computer's hard or floppy disk without so much as an update to your CONFIG.SYS file. *The Flying Dutchman* automatically locates the parallel port you're using, and it includes a handy test of both your cable and port to diagnose problems when you can't make a connection.

With an A-B switchbox and several of Cyco's proprietary parallel cables, the package can act as a poor man's LAN, but simple file transfer is definitely *The Flying Dutchman*'s specialty.

By the time you read this, the company should be shipping Version 5.0, which will include desirable facilities like displays of tree-structured directories and tagging and file sorting options.

Cyco includes an easily understandable 12-page manual that covers the program's basics. In case you need assistance, the company offers free support at a toll number. When it comes to file-transfer speed, *The Flying Dutchman* won't leave other programs in its dust, but it can compete on ease of use.

Hot Wire

by Kimberly Maxwell

DataStorm Technologies' $129 *Hot Wire*, Version 1.0, offers the user simple serial file transfer capabilities between two PCs—whether laptop or desktop—and a variety of disk-management utilities. Among *Hot Wire*'s features is a facility that lets you view, edit, and print files without exiting the program, and special multitasking setup options.

You can use *Hot Wire* to transfer files either through a cable in a direct connection method or, less likely, through a slower modem connection. When you purchase *Hot Wire*, you receive a serial cable with 9- and 25-pin connectors and both 5.25- and 3.5-inch floppy disks chock-full of useful file-management tools and file-transfer utilities. *Hot Wire* supports only serial-port connections at distances from 50 to 75 feet. It acquitted itself quite nicely on our serial-connection performance tests, but for the fastest transfer rates, you need to use products that support parallel connections.

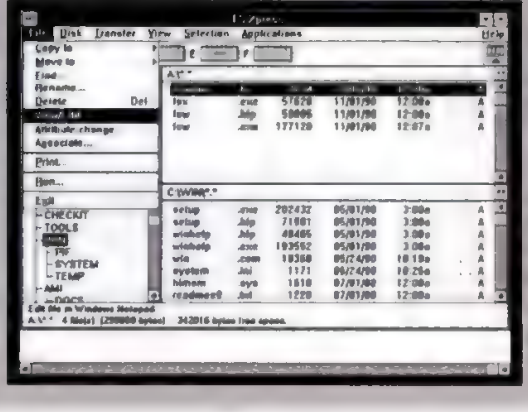
MULTITASKING AND MENUS

Hot Wire can work in a standard DOS environment, but it includes special configuration options for multitasking environments, including *Microsoft Windows* and *DESQview*. *Hot Wire* isn't a special-

The interface problems in these highly competitive products make little impact on real productivity, but that doesn't mean there isn't any room for some improvement.

Like *LapLink III*, *Hot Wire* uses a menu at the bottom of the screen. You have to designate the slave and master machines when you load the program, and only the master computer displays the split-screen interface. A drive letter designates the master computer's subscreen, and a number sign (#) identifies the slave subscreen. Just remember to keep the two markers straight.

***FastLynx's* split-screen mode lists the contents of the local drive on the left side of the screen, and the directory of the remote drive on the right. The program doesn't note a source or destination PC, but the space between the local and remote tags and the drive directories helps make the screen seem less crowded.**



The *File Shuttle Xpress* screen offers a comprehensive graphical user interface. Under *Microsoft Windows*, the program provides easy-to-use pull-down menus, detailed views of the files on the local PC, and disk drive icons that indicate which local drive is in use.

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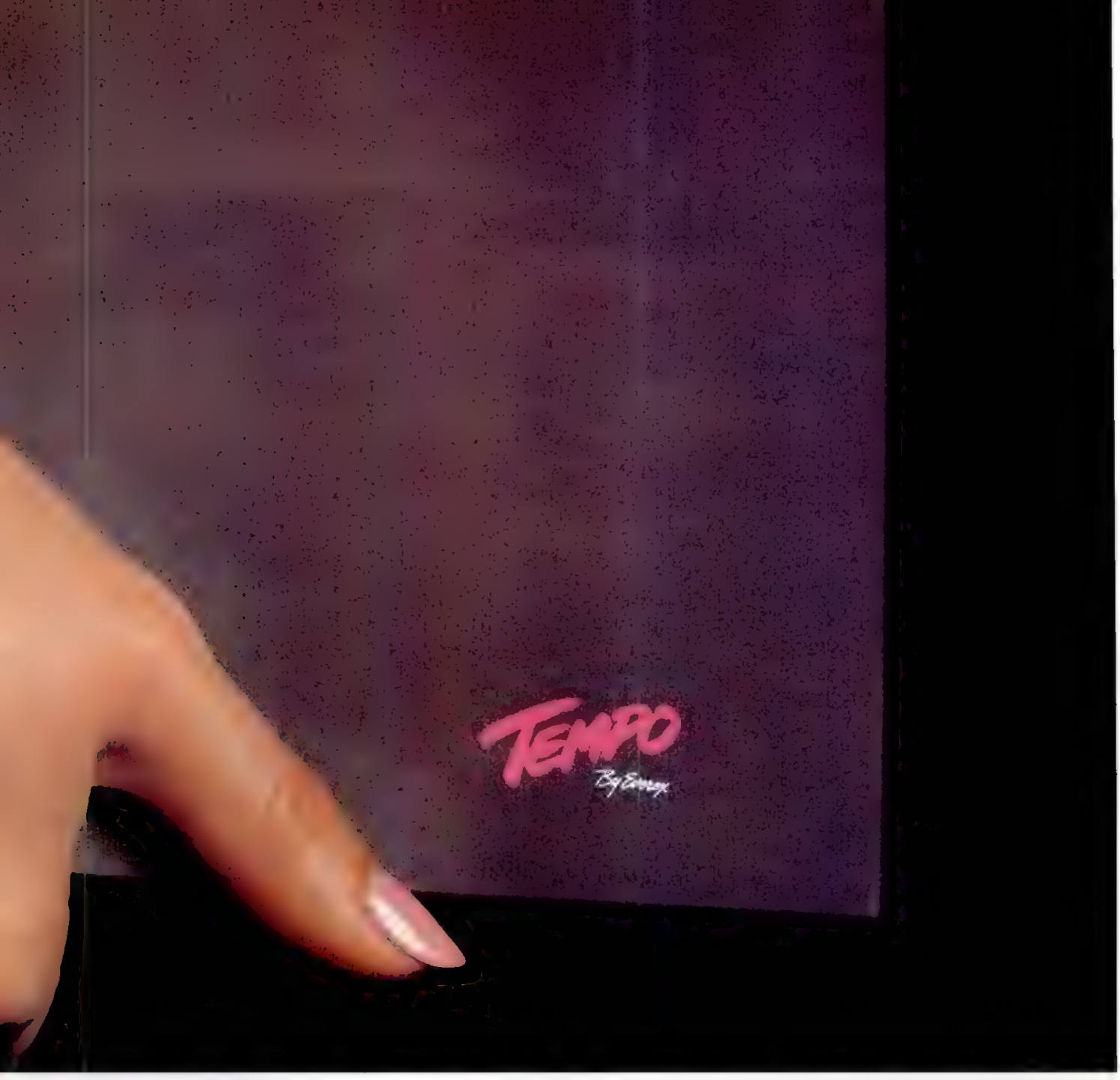

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ized GUI application, but it efficiently includes the Program Information Files needed to run applications under these environments. (We ran our performance tests using *Hot Wire* under DOS only.)

Hot Wire's setup screens sport a blue color scheme, overlapping menus, and a bar across the top. As in the setup screens, *Hot Wire*'s menu operations work so that when you select a submenu, the previous menu is erased (pull-down menus, however, would be preferable). Function keys can substitute for some menu choices.

Once you're past the setup screens, you'll notice that *Hot Wire* places the local and remote PCs in a master/slave relationship (to change roles, you'll have to exit the program and start again). The slave machine shows the progress of file transfers as they occur. The master shows two subscreens, one with the slave's current directory, the other with its own.

The slave-mode screen is simple; it shows information pertinent to the file transfer's progress, including the COM port and baud rate. As a file is transferred, the program displays the filename, file size, block size, total blocks, block count, retry count, and last error reading. A progress bar and percentage report the file's condition during transmission.

On the master machine, you can look at directory trees and subtrees, locate specific files stored on your hard disk, and perform operations (such as create, delete, or rename). A nice feature lets you view, edit, and print a file or set of files without going into a different program's text editor. You can access the slave machine's directory to do the same.

DataStorm Technologies offers support by phone, along with a technical-support BBS and a forum on CompuServe. If you don't mind the master/slave relationship, or connecting by a serial link alone, *Hot Wire* does the job relatively quickly and effectively.

FACT FILE

***Hot Wire*, Version 1.0**
Datastorm Technologies Inc., P.O. Box 1471, Columbia, MO 65205; 314-443-3282.
List Price: With 5.25- and 3 5-inch disks, serial cable, $129.
Requires: 192K RAM, DOS 2 0 or later; serial port on each PC.
In Short: *Hot Wire* offers some handy features, including a moving bar that reports on a file's progress dunng transmission and a facility that lets you view, edit, and print files without exiting the program. Although it is not optimized for environments like *Windows* and *DESQview*, it includes the Program Information Files needed to run applications under those programs.

CIRCLE 416 ON READER SERVICE CARD

LapLink III's menu selections give you great flexibility, but its menu structure has some drawbacks.

LapLink III

by Kimberly Maxwell

Traveling Software's *LapLink*, one of the first file-transfer programs, has evolved to meet users' demands. The latest version, the $149.95 *LapLink III* 3.00, practically jumps out of the box and installs itself. It's a reliable package with fast throughput at a reasonable price.

The kit contains 5.25- and 3.5-inch disks and a special six-headed parallel/serial cable with 25-pin parallel, 9-pin serial, and 25-pin serial port connectors at each end. The program can achieve a signaling speed of 115,200 bits per second over a serial connection of up to 100 feet, but the parallel connection mode provides even faster throughput at up to 20 feet. *Laplink III* scored impressive results on all our performance tests.

You can't go wrong when installing the program. The manual is a model of clear documentation. A remote-install feature allows you to clone the software from a local computer to a remote PC in serial mode, a handy feature for PCs without floppy disk drives.

MENU RIGHTS AND WRONGS

LapLink III's main menu screen consists of two subscreens showing the files on the local and connected machines. The program can treat both PCs as equals, allowing either to control the tasks. You can quickly switch over in the middle of a session, although operations like changing communications ports require that you manually reconfigure the software.

The menu selections give you great flexibility. You can copy whole subdirectories, tag certain files, or use wildcards. You can even tag a few files and specify an action on all untagged files. The Ztree feature provides a graphical tree structure that lets you create or remove subdirectories or files on either PC.

LapLink III's menu structure has some drawbacks, however. The split-screen configuration gives a uniform presentation, but when both screens are full of files, it's easy to confuse the source and destination PCs. We found we had to pay close attention to the small screen labels to avoid taking actions on the wrong computer. A menu selection bar at the bottom shows only a few choices at one time; to move through the bar, you cannot use the more familiar cursor, but must use the Tab, Spacebar, and Backspace keys, or the first letter of the command. Additionally, the Esc key takes you gracefully out of submenu selections, but if you hit it once too often, the program asks if you want to quit. Esc should take you only as far as the main menu.

REPORTS AND AUTOMATED BACKUP

LapLink III includes some handy extra features, including a batch-transfer tool to automate backups and file transfers, a

FACT FILE

***LapLink III*, Version 3.00**
Traveling Software Inc., 18702 North Creek Pkwy., Bothell, WA 98011; 206-483-8088, 800-662-2652 (customer service).
List Price: With 5.25- and 3.5-inch disks, parallel/serial cable, $149 95.
Requires: 256K RAM, DOS 2.11 or later, parallel or serial port on each PC.
In Short: *LapLink III* was one of the first file transfer programs on the market, and it continues to evolve. It provides both parallel and serial connections, and offers handy extras like a report option to keep a log of your activities, a batch transfer tool that can automate backups and file transfers, and the ability to share virtual drives and printers. This remains a standard of comparison in the file-transfer business.

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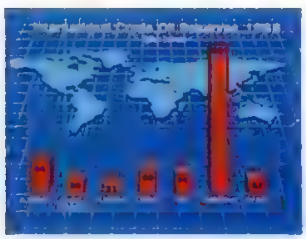

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Excellent documentation, useful installation utilities, and the great six-headed parallel/serial cables make *LapLink III* very easy to run.

report option to keep a log of your activities, and command line operation. The program's device driver also gives a PC redirected virtual drives on the other machine; you can access the disk drives and printers (including network devices) connected to the other computer.

Traveling Software provides free technical support at a toll-free number. *LapLink III* is a proven and practical tool for PC-to-PC file-transfer actions. (Version 4.0, which should be out by the time you read this, promises more extras like data compression, pull-down menus, and mouse support.) Excellent documentation, useful installation utilities, and the great six-headed parallel/serial cables make it very easy to run. This ever-popular choice proves its responsiveness and reliability.

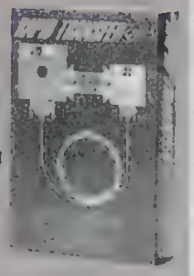
Rapid Transfer Easy

by Lisa Cady Newell

Intertech Marketing's *Rapid Transfer Easy*, Version 1.3, offers just what its name implies: quick (if not lightning-fast), simple file-transfer capability. And at $69.95, a better name might have been *Rapid Transfer Easy and Affordable*.

In our last review of this program (see "File Transfer Software: Building Bridges Between Machines," *PC Magazine*, April 25, 1989), Intertech was known as Systems Management Associates and the program was called *Rapid Relay Easy*. Since then, Intertech has added the ability to view a file in ASCII or hex before transferring it.

FACT FILE



***Rapid Transfer Easy*, Version 1.3**
Intertech Marketing Inc., 8820 Six Forks Rd., #100, Raleigh, NC 27615; 800-762 7874, 919-870-8404.
List Price: With 5 25- and 3.5-inch disks, serial cable, $69.95.
Requires: 128K RAM, DOS 2 0 or later; serial port on each PC.
In Short: *Rapid Transfer Easy* offers both menu-driven and command-line options in an affordable two-station package. While it leaves out some frills, it offers solid performance, one-card Quick Start instructions, and the ability to view a file in ASCII or hex before you transfer it.

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CIRCLE 314 ON READER SERVICE CARD

formance on our tests. With the one-card Quick Start instructions, it took us under 3 minutes from opening the box to transferring files. We connected the serial cable, copied the software onto the disk, executed the program, and went to work. Clear on-screen prompts help the novice quickly find the information necessary to transfer data to the other PC.

Rapid Transfer Easy was designed for users who want a simple way to transfer data between two machines. Within the transfer program, a moving-bar menu simplifies operations. Menu options include transfer, receive, directory, and preferences. The transfer option allows you to send files, subdirectories or logical drives. The directory option lets you specify the subdirectory on the target PC where you want the data sent. And the preferences option enables you to customize the program screens.

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In addition to the moving-bar menu, you can transfer files at the DOS prompt by using the package's RT program. You can also use the RT program in a batch file to automate transfers—a handy option when you need to transfer the same group of files on a daily or weekly basis. But the target PC, which must also be running RT, has to designate which files to receive when you run RT in batch mode.

Rapid Transfer Easy comes with a generic-looking, but very useful, manual.

Rapid Transfer Easy comes with a generic-looking manual that won't win any design awards, but is chock-full of useful information. The documentation's well-written and user-friendly format makes transferring files easy to understand. Help information is frequently displayed at the bottom of the screen.

For more help, customer support is available weekdays at a toll number. *Rapid Transfer Easy* offers a fine way to perform simple file transfer between two machines at an affordable price. ■

Frank J. Derfler, Jr., is workgroup systems editor of PC Magazine. *Kimberly Maxwell is a journalist and frequent contributor to* PC Magazine. *Lisa Cady Newell has experience in systems integration and customer support for PC and mainframe systems. Sara Parker has experience in technical support and user training; she specializes in software systems.*

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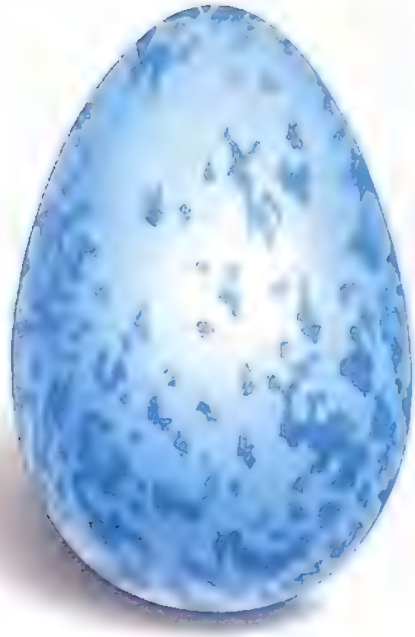

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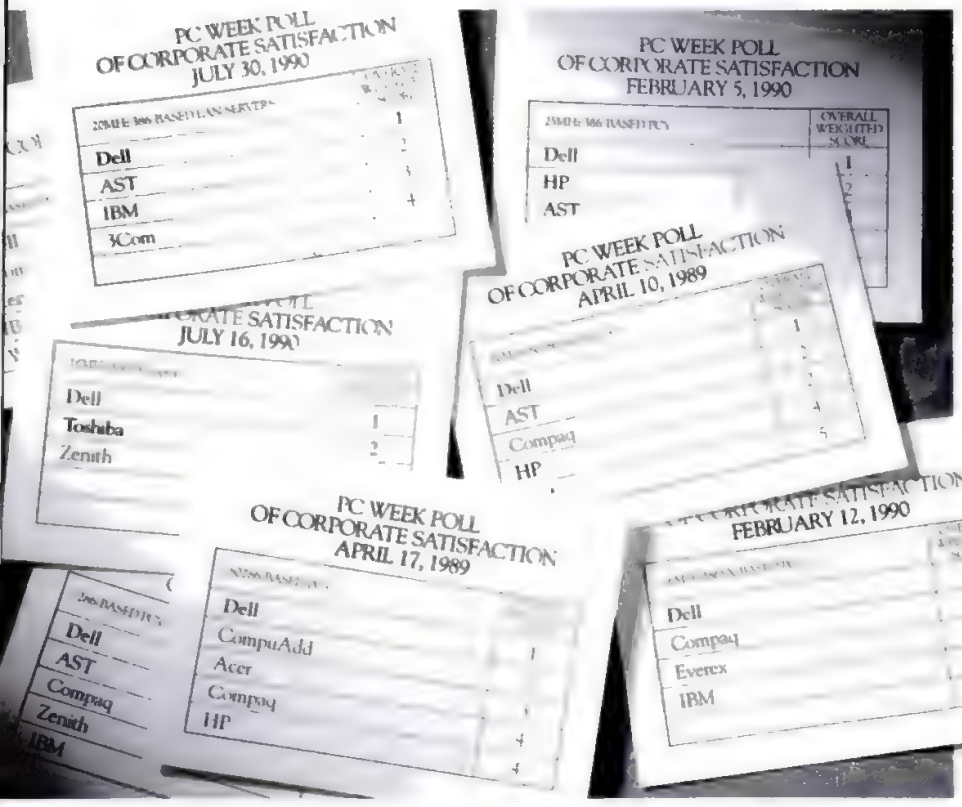

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by Janet Rubenking

Lab Notes

Add a Musical Dimension to Your PC with MIDI

Creating and performing music electronically was once the private preserve of professional musicians, motion picture studios, and television engineers. However, thanks to MIDI—the Musical Instrument Digital Interface—today, the fascinating world of electronic keyboards, synthesizers, sequencers, drum machines, and the like lies open to any musically interested PC user. This Lab Notes will help you explore that world, dispelling the intimidating mystique that often surrounds MIDI equipment and giving you a basic knowledge of how to realize the power that often lies untapped behind its switches and knobs.

MIDI is a standard digital communications protocol that allows music and computer enthusiasts to interconnect synthesizers, sequencers, home computers, rhythm machines and related equipment to create a home studio. Figure 1 illustrates a typical system setup. Computer game companies first brought MIDI to public attention in 1988. The following year, Roland Corp., a leading manufacturer of electronic music instruments, won a *PC Magazine* Technical Excellence Award for its LAPC-1, which combined a hardware interface card with an on-board synthesizer (see *PC Magazine*, January 16, 1990.) Supported by all manufacturers of MIDI equipment, the standard has become more than just a communications protocol for musical instruments. MIDI has expanded in the last few years to meet the demands to control sound, video, and lighting in synchronized productions.

The digital signals (*messages*) that pass through MIDI cables should not be confused with the digital audio signals contained on a CD or DAT (digital audio tape). MIDI signals are *control* signals that tell the connected equipment precisely what sort of analog audio signals to generate and when. Thus, MIDI messages contain performance information such as Note On (when you hit a key on a keyboard), Key Velocity (how hard you hit it), Aftertouch (how much pressure you apply after the initial keypress), Breath Pressure (how hard you blow with a wind controller), and Note Off (when you let the key up). MIDI sends both universal commands that all MIDI devices understand and exclusive commands directed to specific devices. It provides built-in audible metronome timing pulses using a default tempo of 100 beats per minute. MIDI also has absolute timing kept in hours, minutes, and seconds.

■ MIDI equipment has brought electronic music out of the professional studios and put it on the PC.

WHAT GOES INTO A MIDI SYSTEM

For the simplest MIDI systems you don't need a PC at all. You can hook up your favorite keyboard and a sound or drum module with a couple of cables, plug the audio outputs into a stereo system, and pound out your favorite tunes. Serious musicians will include multiple synthesizers, samplers, guitars, keyboards, audio mixers, mergers, and other equipment in their professional studios.

If you wish to record, edit, save, and play back your musical sequences, however, you will need a *sequencer*. A sequencer can be a part of a keyboard, a standalone hardware unit, or—most flexibly—it can be a software application that runs on your PC. Adding the PC interface lets you edit using familiar tools: a keyboard, screen, and mouse.

You will also need an audio system, in order to hear the sounds you create. Most MIDI devices, such as synthesizers, do not come with amplifiers and speakers. (Some provide a headphone jack, but this is not the best output for showing off your musical expertise.) An audio mixer or (in a pinch) a Y-adapter cable can combine the audio signals from several MIDI sources and feed them into your home stereo system or amplified speakers.

THE PC CONNECTION

Regular DOS machines do not come with a MIDI hardware interface, so to connect MIDI devices to your PC, you must add a MIDI interface card that plugs into the PC bus. Although there is a standard for MIDI communications, there is no officially standardized hardware interface, with the result that MS-DOS software varies in its support. The closest thing to a de facto hardware standard was established by Roland when it produced the first MIDI computer interface, the MPU-401 (MIDI Processing Unit, Model 401).

Although the original MPU-401 is no longer being manufactured, its architecture lives on. Roland made its technology available to other manufacturers, and many compatible clones are now readily available. Cards compatible with the MPU-401 include Music Quest's PC MIDI Card, MQX-16, MQX-16s, and MQX-32M; Roland's MPU-IPC, LAPC-1, and MPU-IMC (for the PS/2 Micro Channel bus); and Voyetra's V4000 and V4001. Since many software developers recognize the MPU-401 as the popular standard, there is better software support

for it than for cards that aren't MPU-401 compatible.

There are a few special situations in which the MPU-401 technology is inapplicable, however. Laptop computers, for example, do not have slots for interface cards. Moreover, Kee, a MIDI serial interface manufacturer, has developed a MIDI interface that connects to the RS-232 serial port. Yet another MIDI interface, the Eclipse HRS-3000, uses the parallel port. And there are other non-401-compatible interfaces with a variety of features for 8-bit expansion buses. These include the Mellotron MUART 4-port (sold by Tandy), the SDA (Sound Design Associates) MIDI Interface, and the IBM Music Feature Card. Note that serial MIDI interfaces such as the Kee operate the PC's serial port at higher data rates than those for which it was originally designed and in some cases may have problems handling dense data streams. In any event, if you use a nonstandard (non-401) hardware interface, you will need software specifically designed for it. If the interface does not come bundled with a sequencing program, you should contact the manufacturer.

The various MIDI computer interface cards offer a wide range of different features, and which one you buy will depend both on your personal preferences and on your pocketbook. By spending a little more money, you can get such features as FSK (frequency shift keyed) Time Code, Smart FSK, and SMPTE (Society of Motion Picture and Television Engineers) Time Code, additional ports, and a Metronome Out jack.

These special time codes allow you to synchronize your software with other devices, such as analog tape recorders. Frequency shift keying, for example, transmits control information using audio frequencies that can easily be recorded on a regular tape deck. (Modems use a different type of FSK for sending information over the telephone wires.) Smart FSK is similar to FSK in that it sends pulses at a timing interval relative to the quarter-note tempo of the music. The SMPTE time code is an audio signal that marks time intervals not only in hours, minutes, and seconds, but also in frames, which filmmakers use to synchronize sound tracks with film.

Both Smart FSK and SMPTE (but not FSK) also provide Song Position Pointers (SPP). An SPP is a counter that keeps track of the number of MIDI clock cycles that have elapsed since the start of a sequence. By recording your tone sequences with Smart FSK and SMPTE, therefore, you can use SPPs to mark locations on a track so that you can stop and resume without having to go back to the beginning of the sequence.

If all this is a bit beyond your budget, you can just buy a plain interface card without the special time codes that give you tape synchronization capability.

Metronome Out, a feature most card manufacturers support, is a must for musicians who don't want to listen to metronome beeps coming out of the PC speaker. By connecting the Metronome Out directly to your stereo or other MIDI equipment you can replace the PC speaker beep with a more palatable percussive sound.

Moreover, don't overlook the MIDI interface cards (the Roland LAPC-1 and the IBM Music Feature card are good examples) that also have a built-in synthesizer on the card. While these are more expensive than a plain hardware interface card (even with FSK and SMPTE), they cost about the same as the total price of a low-end hardware interface card plus an external synthesizer.

Someday, in addition to its standard communications protocol, MIDI equipment will presumably have a hardware-independent interface standard. When that happens, you'll be able to choose any hardware and software from different manufacturers and know that they will be compatible. Right now, however, each MIDI application uses its own device driver, so you must check hardware-software compatibility before you buy.

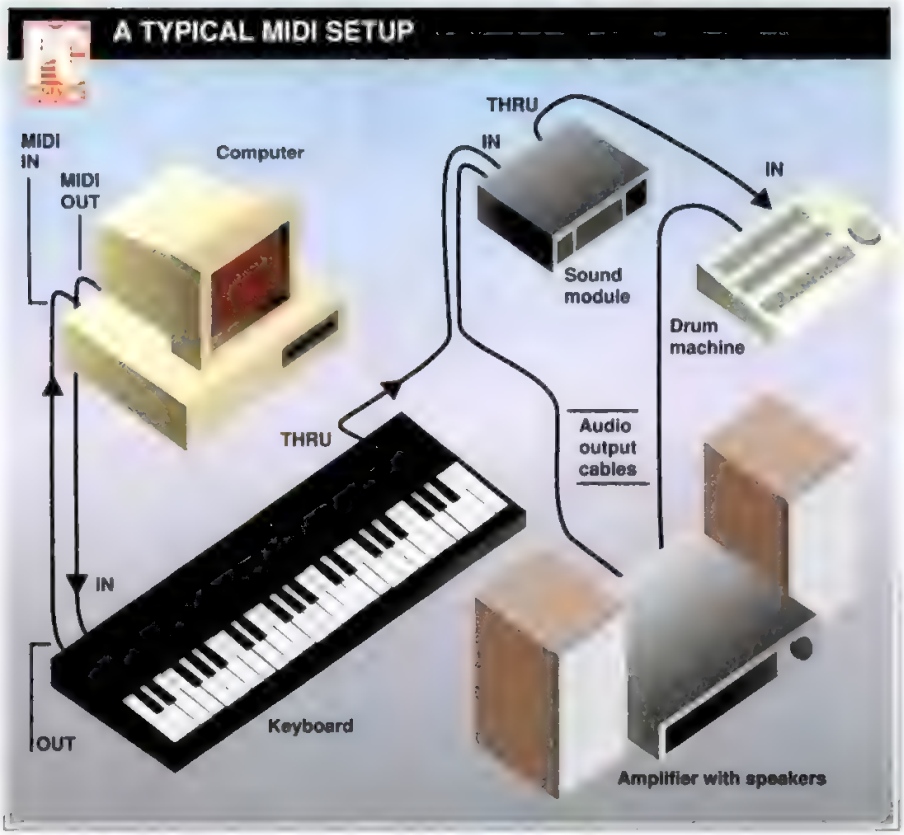

Figure 1: The various interconnected MIDI devices respond to digital messages that control the analog audio signals you can play through your stereo system.

TYPES OF MIDI DEVICES

MIDI equipment can be divided into MIDI *instruments* and MIDI *devices*. The former include keyboards, guitars, and even wind instruments. MIDI devices include synthesizers, samplers, controllers, sequencers, and drum machines. Some of these latter provide such features as analog audio output circuitry, front-panel controls, and even windows that display messages.

MIDI instruments and devices communicate through their own internal microprocessors. They translate your "input" (pressing a key on a MIDI piano or strum-

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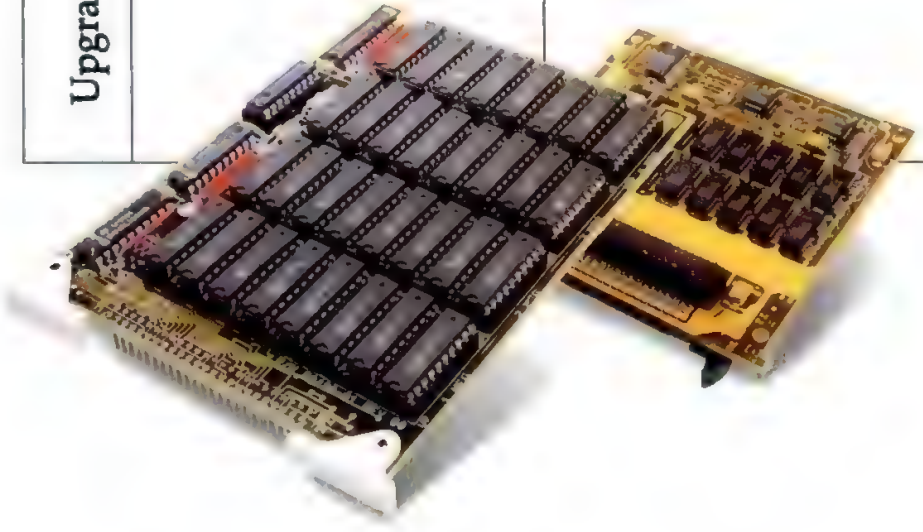

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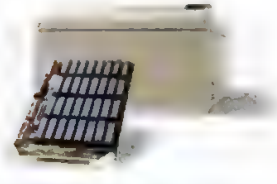

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ming a MIDI guitar) into digital signals that are then sent to the microprocessor. The microprocessor takes the signal and sends it to the voice circuits.

Some MIDI devices are sound sources (that generate audio signals) and some are performance controllers that have no audio circuitry. Synthesizers, samplers, and sample playback units are all sound sources. A synthesizer is an instrument that creates and defines its own audio signals using oscillators, filters, ADSR units (attack decay sustain release—or envelope controller), and related circuitry. All synthesizers create new sounds, but each type of synthesizer has its own unique range of sounds. (See the sidebar "The Process of Making Sound," for more information on sound synthesis).

A sampler does not create its own sounds—it simply records outside sounds digitally and plays them back. An analog-to-digital (A/D) converter chip converts the incoming audio signals into a stream of 1s and 0s that can be stored digitally in the sampler's memory. To play back the sound, the sampler uses a digital-to-analog converter (DAC) to turn the digital data back into audible sound.

The sample playback unit is like a sampler except that it only plays back preset sounds that have been burned into its ROM. In general, synthesizers are good at producing simulated sounds; samplers and sample playback units are good at reproducing the sound of real instruments. Professional musicians will often have several synthesizers and samplers in their sound library.

A *controller* is a keyboard or other musical instrument that does not generate audio signals on its own: you must connect it to a sound source to make sounds. There are wind controllers for woodwind and brass players and guitar controllers for guitar players.

A sequencer is a device that records and plays back MIDI messages. It is like a multitrack tape recorder, except that what it records are digital MIDI events rather than analog sounds. A sequencer often provides a timing reference for synchronization with audio tape recorders, drum machines, and other sequencers.

Drum machines combine sound-generating circuitry with a sequencer. The sounds generated are short samples of drum and percussion instruments. A drum machine should always provide a means for synchronizing with other devices. Many use FSK synchronization, but MIDI Time Code and SMPTE Time Code are supported by some.

MIDI COMMUNICATIONS

A MIDI connection transmits data asynchronously at 31,250 bits per second. Each byte requires a total of 10 bits—a start bit, 8 data bits, and a stop bit. MIDI data is transmitted along shielded twisted-pair cables that have a maximum length of 50 feet

THE PROCESS OF MAKING SOUND

by Janet Rubenking

Sound synthesis is simply a process of creating the various waveforms that produce the sensations we call *sound* by artifical—usually electronic—means. The simplest—and most musically boring—sounds are pure sine waves, which you can produce acoustically by blowing across the top of an open bottle or electronically by using a sine-wave oscillator. You can visualize sine waves by imagining a series of smooth ocean swells: one complete peak and trough cycle traces a single sine wave. The forth-and-back motion of a loudspeaker cone correspondingly compresses and rarefies the surrounding air, so creating sound waves.

Over the 360 degrees (one cycle) of this simple waveform—180 degrees positive, 180 degrees negative—the amplitude of the wave varies smoothly but continuously in proportion to the sine of the angle. The number of complete cycles per second is the *frequency* of the tone, or roughly speaking, what we call its *pitch*. The standard A pitch to which orchestras tune has a frequency of 440 Hz (cycles per second).

Musical instruments—conventional and otherwise—create very complex (and hence more aesthetically interesting) waveforms, which themselves vary considerably over the duration of the note (particularly at its onset). However complex, the distinctive timbres of musical sounds can all be mathematically analyzed in terms of combinations of sine waves: a fundamental frequency plus a series of harmonics (integer multiples of the fundamental) mixed in various proportions. (These harmonics are called *distortion* when your hi-fi set adds them on its own!)

You may think it's strange that simple sine waves could be combined so as to form the sound of, say, a trumpet, but Fourier's mathematical analysis can be applied to all sound sources. Even a "square" wave—an alternate series of positive and negative pulses—turns out to be nothing more than a fundamental and a series of odd-numbered harmonics.

Using the results of wave form analysis, sound engineers have thus devised various methods to synthesize sounds *back* again from their component parts. Most modern synthesizers take multiple waveforms generated by oscillators (sine wave, square wave, triangle wave, sawtooth wave, and other generators) and combine them—often with harmonic-sensitive filters—to re-create the realistic sounds of known musical instruments—or of never-before-heard sounds. For example, classical additive synthesis creates musical waveforms simply by adding large numbers of sine waves with precise frequencies and amplitudes whose values are adjusted over time using envelope generators.

Unfortunately, precisely to duplicate a known sound through this method requires a near-infinite number of sine waves. Additive synthesis has been impractical in the past because the available microprocessors could not handle the vast amounts of data in real time. Less computation-intensive methods of waveform creation, such as FM synthesis, have proved more practical. (See *PC Magazine*, November 20, 1988.)

There are yet newer methods of synthesis on the horizon. Two of these are *physical modeling*, in which the synthesizer actually simulates the mechanical

(15 meters) and are terminated by 5-pin male DIN connectors at each end. The MIDI signals use pins 4 and 5, and pin 2 serves as the ground. At this time, pins 1 and 3 are unused.

In a MIDI system, the master device (the computer or the controller) transmits the messages to which the slave devices (synthesizers, samplers, and the rest) respond. The MIDI specification defines 16 separate message channels (0 through 15), all of which use the same cable. Any number of slave devices can respond to the same channel, and a single slave device can respond to multiple channels.

All MIDI devices provide some combination of IN, OUT, and THRU ports, and all of these use 5-pin female DIN connectors. MIDI messages travel in only one direction through a cable, so separate cables are necessary for connections to each port. The master source sends information through the OUT port. The slave device receives this information through its IN port. The slave can then copy this information and pass it along to another slave device through its THRU port.

Some MIDI devices are sound sources and some are performance controllers that have no audio circuitry.

Because MIDI data is transmitted serially at a 31,250-bit-per-second rate, there is always a slight delay each time a MIDI device must copy the data from its IN port to its THRU port. Thus, if you try to chain more than three MIDI devices together via the THRU ports, you can encounter timing problems: the units farther down the chain will not be in sync with the devices at the top. You can avoid this problem by using a MIDI THRU box. The THRU box has a MIDI IN and four to eight MIDI THRU ports to which the data is copied simultaneously. Thus, data is sent to all the slaves simultaneously rather than passing from one device to another in sequence. Figure 2 illustrates how the MIDI THRU box connects the master source to the slaves simultaneously.

MIDI CHANNEL AND SYSTEM MESSAGES

Each MIDI message consists of a status byte and possibly some data bytes.

Status bytes are 8-bit binary numbers whose most significant bit (MSB) is set to 1. A status byte identifies the message type and thereby determines the data bytes that will follow it. The arrival of a new status byte takes immediate priority and commands the receiver to adopt the new status, even if the last message has not been completed.

Data bytes are 8-bit binary numbers in which the MSB is set to 0. Receivers will ignore data bytes that are not preceded by a valid status byte and will not act on the message until the correct number of data bytes arrive. As indicated above, if another status byte arrives before all of the data bytes, the pending message will be ignored.

There are two types of MIDI messages: *channel* and *system*.

Channel messages send a command to a specified channel. The 4 high-order bits in the message define the command, and the 4 low-order bits specify the channel number. Channel messages are further divided into *voice* messages, which are actually commands to do something, and *mode* messages, which control how the device responds to the voice messages.

Channel voice messages are generated when you play on a MIDI instrument. Each message consists of a status byte followed by 1 or 2 data bytes. The specific message determines the number of data bytes.

There are seven recognized channel voice messages.

- Note On and Note Off messages signal the beginning and end of a note.
- Polyphonic Key Pressure messages indicate the pressure you apply to a key.
- Channel Pressure messages reflect ad-

actions of the musical instrument it is re-creating, and *granular synthesis*, in which the synthesizer manipulates discrete *grains* of sound rather than waveforms.

Physical modeling uses complex mathematical formulas to replicate the mechanical behavior of acoustic instruments. A mathematical formula describes each sound-generating and sound altering component of an existing musical instrument. One physical modeling algorithm, called Karplus-Strong, uses a digital filter to represent the motions of a string (which creates ordered vibrations) together with a short noise burst to simulate the random vibrations of the initial string pluck.

When using the Karplus-Strong algorithm, a buffer is set up to hold enough samples to constitute one period of a waveform. When the note begins, the buffer loads samples one at a time to the digital filter and the filter returns the processed samples back to the beginning of the buffer. The repetition results in a quick transition from a random vibration to an ordered vibration, comparable to what happens with a real string instrument.

Physical modeling can mathematically describe each physical interaction of a vibrating acoustic system. This type of synthesis requires extremely accurate mathematical models in order to work, however, and creating such models is an astonishingly difficult task. Physical modeling is somewhat far from common use—though it may be the method of choice in the future.

Like FM synthesis, granular synthesis builds complex sounds from simple objects. But whereas the basic building blocks in FM synthesis are simple harmonics, in granular synthesis they are *sonic grains*, time slices of sound that each have a duration (measured in milliseconds), a waveform, and an amplitude envelope. By combining these discrete grains, the synthesizer can create extremely rich and complex sounds.

Granular synthesis is closer to becoming a commercial reality for music synthesizers than is the physical modeling approach, but both provide better methods than are currently available for creating the ever-elusive perfect sound. ■

ditional pressure being applied while depressing a key. This message represents a single pressure value for the channel. It differs from Polyphonic Key Pressure in that one message is generated regardless of the number of keys depressed.

- Control Change messages respond to real-time control applied to an instrument, as when you use the foot pedal, modulation wheel, or breath controller.
- Pitch Bend Change messages similarly indicate when the pitch bender lever or wheel on a synthesizer has been moved to raise or lower the pitch of a sound.
- A Program Change message specifies by number which preset sound the channel should play. Since it contains only a number, the same message may produce a different sound from different devices.

If the instrument generating the voice messages is connected to another MIDI device set to receive them, the receiving instrument will respond as if it were itself being played directly. You can select the type of response to voice messages for the receiving and the transmitting devices by selecting a channel mode of operation.

The four channel mode messages are OMNI On/Mono, OMNI Off/Mono, OMNI On/Poly, and OMNI Off/Poly. These messages control whether a device uses one or many channels and whether it can handle one or many notes per channel.

System messages control the entire system, not simply the devices on a specific channel. System messages are divided into: common messages, to which all devices respond; real-time messages, which are used principally for synchronization; and system-exclusive messages, which are meant for MIDI devices of a particular brand.

A System Common message goes to all devices in the system—those that can't respond to it simply ignore it. The System Common messages are MIDI Time Code, which is used for synchronization; Song Position Pointer, which marks a given location within a MIDI sequence; Song Select, which triggers a preset "song" (tone sequence) from a sequencer or drum machine; Tune Request, which instructs the devices on the system to perform their on-board tuning routines; and End Of Exclusive, which marks the end of a System Exclusive message. Depending on its type, a System Common message may have 0, 1, or 2 data bytes.

> By using The Standard MIDI File format—and sequencing software that supports it—musicians are able to share sequences with each other.

System Real-Time messages are also sent to all the system devices. There are no data bytes associated with the status byte of these messages, and they can be sent at any time—even between the data bytes of a different message. The Real-Time messages are Timing Clock, which is transmitted 24 times per quarter note; Start, Stop, and Continue, which are triggered when you press the corresponding button on the master device; Active Sensing, which is used to ensure that the device is still connected; and System Reset, which tells each device to return to its default settings.

System Exclusive (SysEx) messages are generally intended for one specific brand of synthesizer or other MIDI device. Such messages begin with the SysEx status byte (F0h), which is followed by a byte that uniquely identifies the equipment brand. Next come any number of data bytes, ending with an End Of Exclusive message or any other status byte. Instruments that don't match the device ID simply ignore the SysEx message.

An ordinary stream of MIDI voice messages consists of a series of status bytes followed by their data bytes. And most of those status bytes will be Note On messages. The first data byte of a Note On message specifies the pitch (the note number—middle C is 24h), and the second data byte indicates the *velocity*—roughly

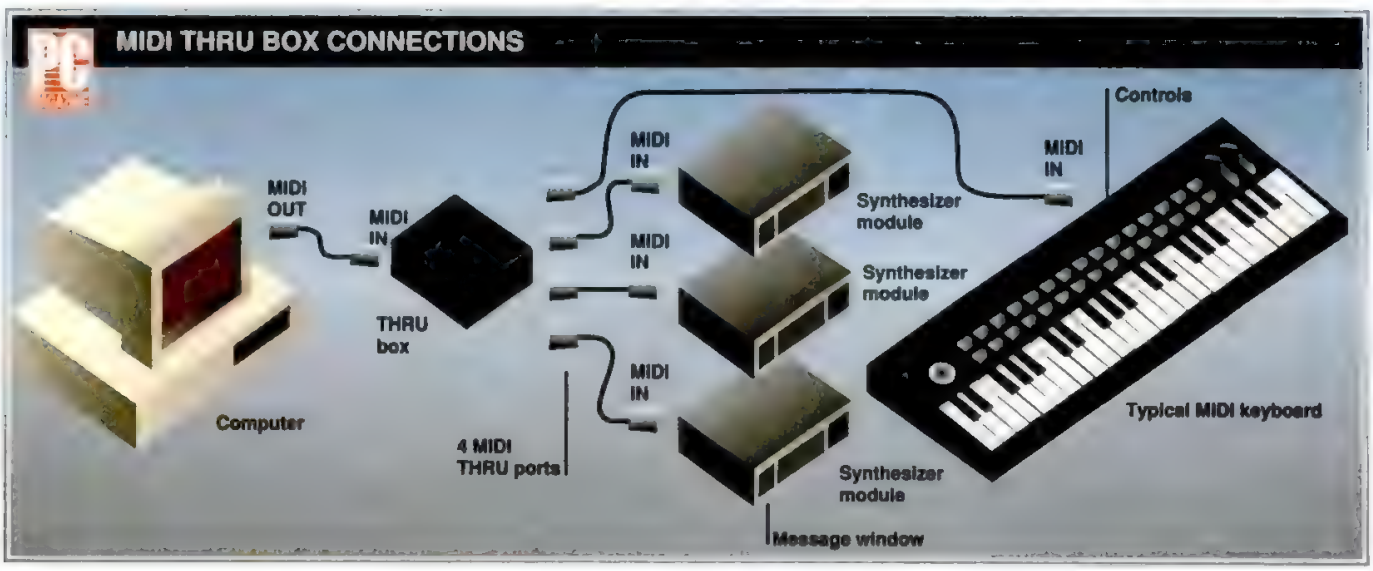

Figure 2: By using a MIDI THRU box, the same control signal from the master device is simultaneously made available to all the slave devices, thus maintaining synchronization.

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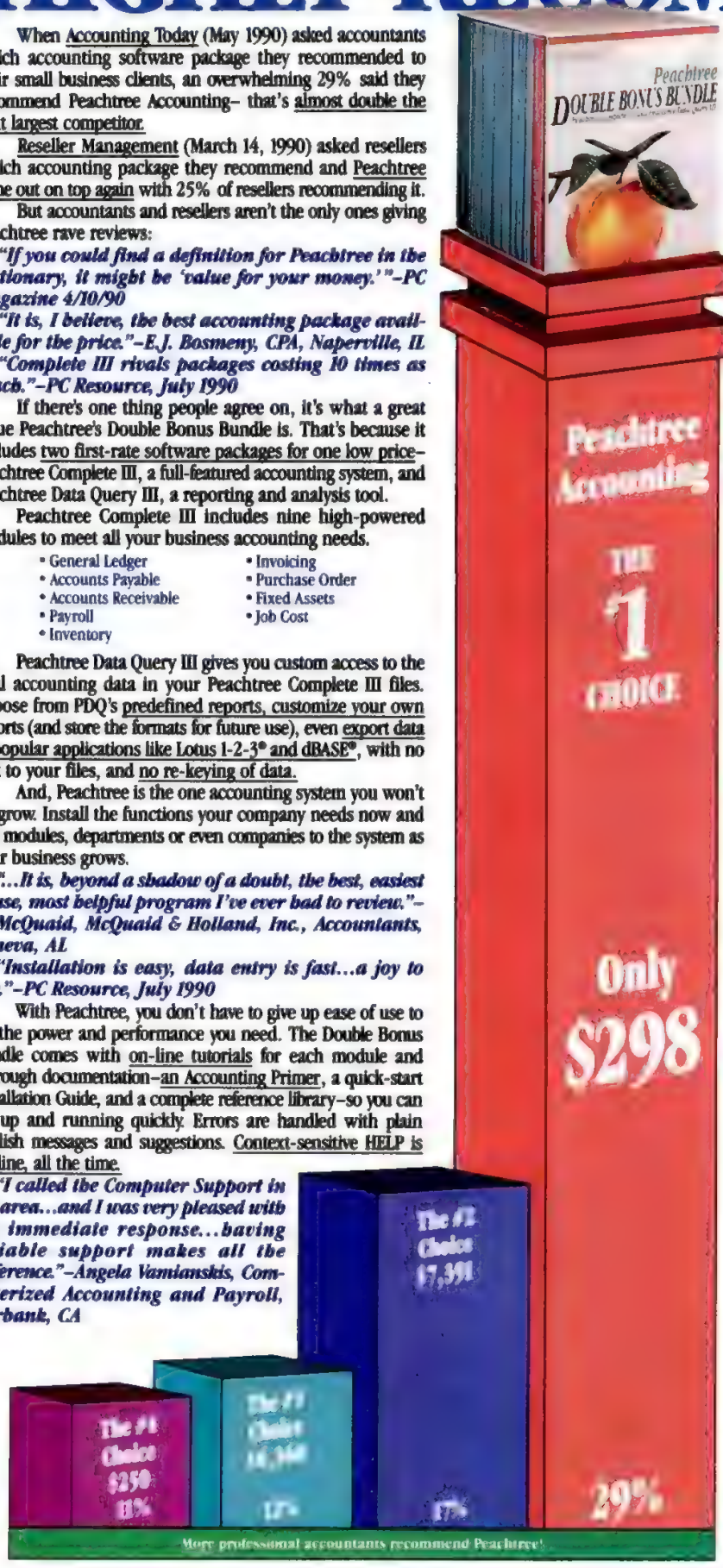

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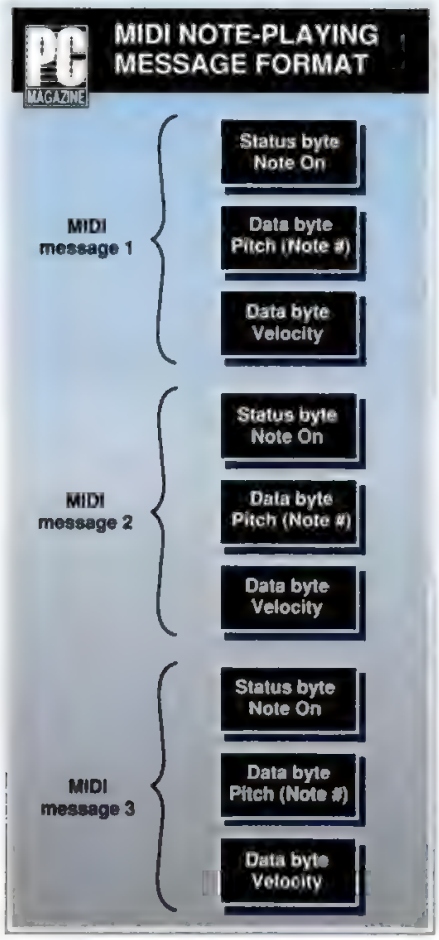

Figure 3: When playing a series of notes, the stream of MIDI messages ordinarily contains a series of redundant Status Note On bytes followed by Data bytes.

speaking, the amplitude of the note. A Note On with velocity of zero is equivalent to a Note Off, so the latter message is rarely used.

As shown in Figure 3, therefore, a very simple series of notes being transmitted from a MIDI device would consist of Note On, Pitch, Velocity, Note On, Pitch, Velocity, over and over. This is a standard format that all MIDI devices understand. But most MIDI devices can recognize *Running Status*. This can reduce the number of bytes in the data stream by a third. The basis for Running Status operation is simple: if the device sees another data byte when it was expecting a status byte, it assumes the message is a repeat of the same status byte it just used. Thus, as shown in Figure 4, a long series of note messages can be reduced to Note On, Pitch, Velocity, Pitch, Velocity, and so forth. By using Note On with the velocity byte zero instead of using Note Off, you avoid changing the status byte.

STANDARD MIDI FILE FORMAT

In 1988, the Standard MIDI File (SMF) format (developed by Dave Oppenheimer of Opcode Systems) was adopted by the MIDI Manufacturers Association. By using this format—and sequencing software that supports it—musicians can share sequences with each other regardless of the type of computer each uses (Macs are more common in this field than PCs). SMF is also useful for sharing files over major networks, like CompuServe. Thus, just as the MIDI technical standard allows MIDI hardware from different manufacturers to connect seamlessly—the SMF format allows the sharing of MIDI data from different sources.

SMF files are made up of what are un-

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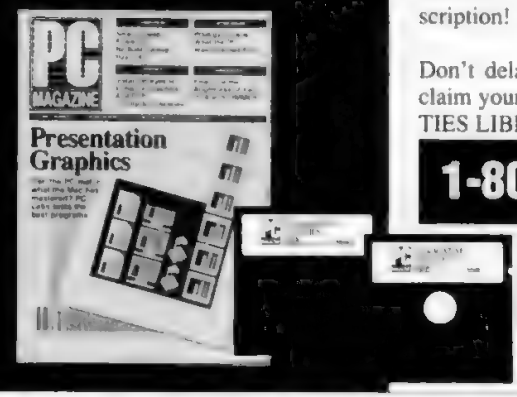

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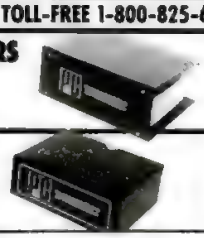

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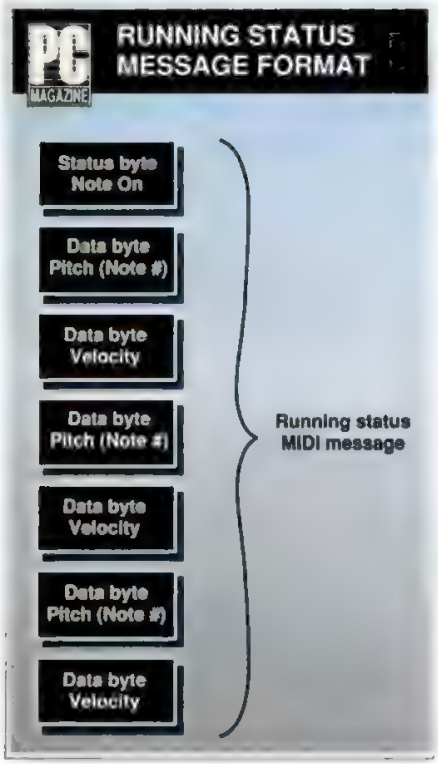

Figure 4: MIDI equipment that recognizes Running Status speeds up message handling by eliminating unneeded Status bytes.

ceremoniously called *chunks*. The first 4 bytes comprise an ASCII identifier—commonly MThd for a header chunk and MTrk for a track chunk. The next 4 bytes form an integer that defines the length of the chunk's data part, which follows. Thus, a chunk whose length byte is 6 occupies 14 bytes in the file: 4 bytes of ID, 4 bytes of length, and 6 bytes of data.

The header chunk contains the information needed to interpret the track chunks that follow. The header data consists of three 2-byte quantities: the format, the number of tracks, and the *division*. (We'll discuss format and number of tracks below.) The *division* specifies the kind of timing to be used in the file, for example, whether it is relative to the length of a quarter note or is absolute (MIDI Time Code or SMPTE).

A track consists of a sequential stream of MIDI data that may contain information for up to 16 channels. A track chunk contains all the commands and data for one track of a sequence. A number of track chunks will thus create multiple tracks, which can employ multiple MIDI outputs, patterns, and sequences.

Before each MIDI message there's a delta-time value of 1 to 5 bytes, in an unusual variable-length format. The delta-time is the time since the previous event began. Besides the all-important channel message events (the notes!), track chunks can contain system-exclusive events and "meta-events" such as tempo changes, a copyright notice, and even lyrics.

Since the MIDI header chunk uses 2 bytes to store the format number, there is a possibility of 65,536 different formats. In practice, however, as diagrammed in Figure 5, there are actually only three. In Format 0, the file contains a single multichannel track. With this format, all events for all channels go into a single track chunk. Format 1 has several simultaneous tracks. Although they appear one after another in the file, the tracks play back at the same time. In Format 1, all tempo information must be in the first track. The little-used Format 2 is similar to Format 1 but it allows each track to have its own tempo events.

A wide variety of MIDI software is available to make your recording sessions easy, but the programs must be compatible with your hardware.

SOFTWARE

A wide variety of MIDI software is available to make your recording sessions smooth and easy. Be warned, however, that many of these programs have steep learning curves and that you must always be careful to select programs that are compatible with your hardware. Better yet, if you're just starting out, decide what software you want to run and select compatible hardware.

Sequencers, notators, editors, and librarians can range in price from under $100 to over $800. The After Hours section of *PC Magazine* runs reviews of MIDI software and interface cards, and you'd be wise to read up on them before going to your local software or music store (See our March 29, 1989; November 29, 1988; and September 13, 1988, issues.) You can also download demos of some of the most popular programs from the MIDI forum library on CompuServe.

A *sequencer* is much like a multitrack tape recorder. It records the parts you play on the keyboard and then plays them back when you command it to. But a sequencer

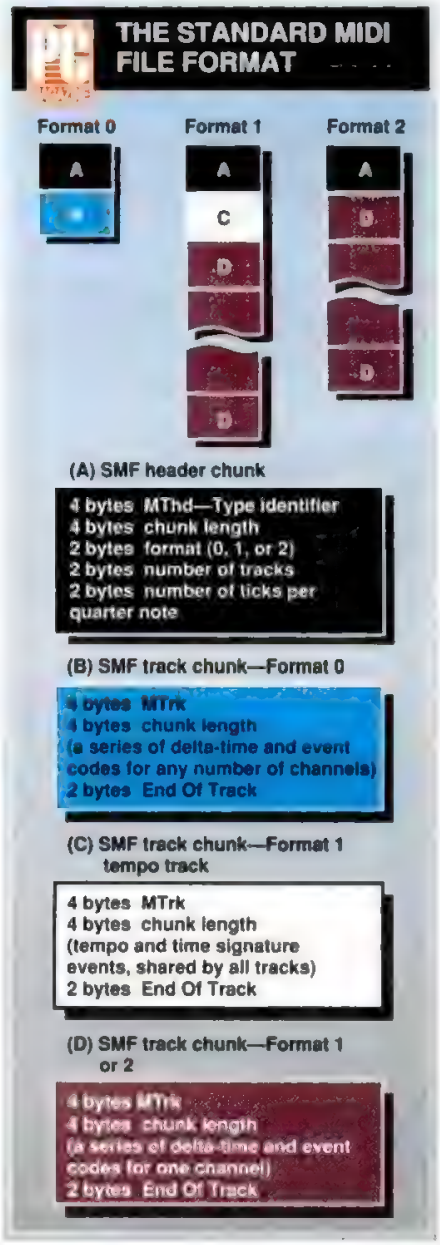

Figure 5: Standard MIDI Files allow musicians with different computer systems to share tone sequences. Three formats, consisting of header and track "chunks," are recognized. The first and second consist of header and track chunks.

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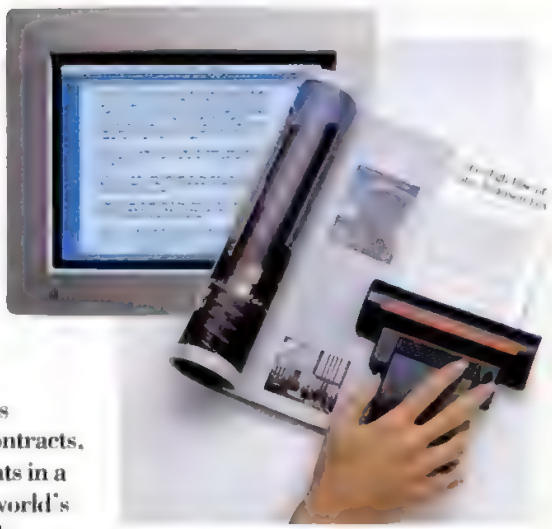

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A BRIEF MIDI GLOSSARY

by Janet Rubenking

A/D (analog-to-digital converter) A chip that converts analog signals to digital (binary) format.

ADSR An acronym for *attack* (how fast the volume builds up), *decay* (how quickly it decays), *sustain* (the output level during the sustain if a key is held down), and *release* (how long it takes for the sound to vanish).

Aftertouch The amount of pressure applied after the initial keypress.

Controller A keyboard or other type of instrument that does not itself generate audio signals, but controls a separate sound source.

Envelope A description of the attack, decay, sustain, and release of a sound.

Fourier analysis A branch of mathematics used to analyze repeating or periodic phenomena, such as sound waves.

Frequency Modulation (FM) Sound-wave patterns that are represented by variations in the frequency of a carrier signal whose average frequency is above 1 MHz.

Frequency Shift Keying (FSK) A method of transmitting data at audio frequencies.

Hertz (Hz) The unit for measurement of frequency; with sine waves, 1 Hz is equivalent to 1 cycle per second.

Key velocity How hard a key is struck; generally proportional to the amplitude of the signal.

Librarian A software program designed to store new and preset sounds that have been created with a synthesizer onto a disk.

MIDI (Musical Instrument Digital Interface) A standard communications protocol used by electronic music equipment.

MIDI THRU box A device that connects multiple slave devices simultaneously to a master controller's signal.

Notator A software program that translates keyboard input and output into a notes-on-the-staff format that can be played back or printed out.

Pitch The frequency of a sound wave as perceived by the ear; its highness or lowness.

Sequencer A device or software application that records and plays back MIDI sequences.

Sound frequency The physical rate at which acoustic vibrations occur, measured in Hertz.

SMPTE (Society of Motion Picture and Television Engineers) Time Code A method of timing in seconds, minutes, hours, and frames that facilitates synchronizing music to film frames.

Timbre The sonic characteristics that distinguish the tone of one instrument from another, as determined by the shape, material, attack, and envelope of the waveform; also tone color. ■

goes far beyond the control abilities of a tape recorder. A sequencer actually allows you to perform many editing operations directly on the MIDI data. The number of tracks that a sequencer handles varies—*CakeWalk* can accommodate 256 tracks, while *Cadenza* offers 64.

You can change a sequence locally, adjusting pitch, velocity, and other parameters of individual notes. Or you can make sweeping global changes—transpose the piece to another key, change its tempo, or cut, copy, and paste whole sections. Change the violin part to a saxophone, just to see what happens. You can't do *that* with a tape recorder!

A sequencer remembers the pitch of the notes you play and what sound you used for each note, but it will remember the sound only as the sound number for the synthesizer you are using. If you save a sequence to an SMF file and try to play it back through another synthesizer, chances are the sequence will sound different. The mapping of sound numbers to actual sounds is specific to each synthesizer—even the same synthesizer may have the ability to load a different set of sounds to the 128 available sound numbers.

MIDI also means that composers need no longer pay a scribe to laboriously pen down every note of a new score. A *notator* allows you to input the keyboard information and output it in a notes-on-the-staff format. You can then play it back or print it out as instant sheet music.

An *editor* allows you to manipulate the preset sounds that come with your synthesizer. Editors usually come with a *librarian*, which you can use to save the new and preset sounds to disk. (Some synthesizers will accept RAM cards, to which you can also save the sounds.) Keyboards come with a number of sound patches (to turn them into different instruments), and many times you can buy third-party patches on-disk to add to your sound library. Or you can use an editor to change the existing patches and create your own new sounds.

In a word, MIDI is incredibly versatile. You can enjoy it as a hobby, compose serious musical pieces with it, share your songs and sequences with friends, or use it in really high-tech fields such as the motion picture and television industry. Try re-creating Beethoven's *Fifth* in the sound of Harpo's horn if it suits you. Multimedia events are hot this year, and no one needs to suffer silent pictures: let MIDI provide the sound. ■

Janet Rubenking is the former sysop for Sierra On-Line *and editor-in-chief of the San Francisco PC Users Group newsletter* Blue Notes. *She is a free-lance writer and consultant in San Francisco.*

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Utilities

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Admittedly, these may not be routine chores, but when the need arises, you'll be glad you have this issue's utility pair, 2FILE and 2FLOPPY. 2FILE creates an exact, sector-by-sector image of an entire floppy disk as a single file on your hard disk. You can then send this file (compressed, if you like, with a utility such as ARC, *PKARC*, or *PKZIP*) via modem to an associate 2,000 miles away. When he receives the file, he simply runs the complementary utility, 2FLOPPY. 2FLOPPY formats a disk, copies the 2FILE disk image file to it, and verifies the copy.

Alternatively, you can use the 2FILE image file on your hard disk as a duplication master. When you run 2FLOPPY, you can tell it you want to make 50 copies. It will then format, copy, and verify the disks, prompting you to insert new ones as you go. You'll still need to insert 50 disks into the drive, of course, but you won't have to keep going back and forth to the original.

The easiest way to get 2FILE.EXE and 2FLOPPY.EXE is to download them from PC MagNet. See the instructions on the PC MagNet News page following the article. If your communications setup can't handle binary files, download 2FILE.BAS and 2FLOPPY.BAS; they will automatically create the .EXE files when you run them in BASIC. Both utilities are written in C, and you can also download the appropriate source file sets from PC MagNet, if you wish.

You can also get a copy of the source code listings by mail or fax. Simply send a postcard with your name and address (or fax number if applicable) to the attention of Katherine West, Utilities, *PC Magazine*, One Park Avenue, New York, NY 10016; no phone calls, please.

■ When you need to send an exact disk image or duplicate floppies on a one-floppy system, this set of utilities is the only sensible answer.

USING 2FILE

The syntax used to invoke 2FILE is

```
2FILE d:
[e:][\path\]filename[.ext]
```

where *d*: is the letter of the *source* drive, that is, the floppy disk drive containing the disk you wish to copy into a single file. The *filename*, preceded by an optional drive and path, is the name to be used for the file that will be created on your hard disk. If either parameter is missing, the program will display an error message and exit. If you omit the extension, 2FILE will supply .FLP as the default. If no target drive and path are designated, the currently logged drive and path will be used as the default for the destination file. Thus, for example, entering

```
2FILE b: letters
```

will copy the floppy disk in drive B: to the file LETTERS.FLP in the current subdirectory of your current drive.

Note that 2FILE will write only to a disk drive that's different than the source drive. The destination drive must have enough space available for a file the size of the original disk plus 13 bytes. (The first 13 bytes of the file are used for a header that identifies it as a 2FILE file of a certain-size disk.)

The 2FLOPPY syntax is

```
2FLOPPY d: [e:][\path\]filename
[.ext] [/number] [/Q] [/V]
```

where *d*: is the *destination* drive, namely, the floppy disk drive to which the designated 2FILE *filename* will be copied. If no optional source drive (*e*:) or path is supplied, it is assumed that *filename* is in the current directory on the current drive. Unless specified, it is also assumed that the 2FILE file has the default .FLP extension.

The remaining three parameters are optional and can be entered in any order. The */number* parameter is the number of copies you wish to make. This can be any number from 1 (the default) to 32,767. If you specify a number greater than 1, 2FLOPPY will beep and prompt you to insert a new disk when it's ready to make the next copy. If no beep is desired before the disk-change prompt, simply enter the /q (for "quiet") switch.

By default, after 2FLOPPY writes a track, it verifies the data by comparing what it read with what it wrote. Entering the /v parameter tells 2FLOPPY *not* to verify the copy. Turning off verifying will speed things up, but if your need for accuracy is great enough to want to use an

equivalent for DISKCOPY, you will normally want to leave verification on. Note that the /q and /v parameters can be entered either in upper- or lowercase.

DOS FLOPPY DISK DETAILS

To understand how 2FILE and 2FLOPPY work, it will be useful to review the types of diskettes DOS supports and how data is organized on them. As shown in Figure 1, there are currently seven main types of diskettes.

Almost all of today's disks can hold data reliably on both sides; a single-sided floppy is simply one that failed the manufacturer's tests on one side. The normal 360K floppy is known as a *double density* disk. Double density disks have 40 tracks per side, with up to ten (although nine is considered safer) sectors per track.

Unlike a phonograph disk, whose groove is a continuous spiral from the outer to the inner circumference of the storage area, the tracks on a floppy disk are separate concentric circles. For this reason, they are also called cylinders. Each arc-shaped sector of each track can hold 128, 256, 512, or 1,024 bytes of data; in normal DOS configurations, a sector size of 512 bytes is used. DOS normally reads and writes a disk in *clusters*, which are comprised of groups of one or more sectors.

The 720K, 1.2MB, and 1.44MB floppy disks are designated as *quad density* disks. These can contain up to 80 tracks per side, with up to 18 sectors per track. This higher data density is made possible by using a higher-coercivity magnetic coating. (*Coercivity* is the measure of the magnetic force required to change the particles from a north-south to a south-north polarity. In a low-coercivity formulation, the magnetic particles are easily affected, so a concentration of "1-oriented" particles could reverse a significant number of "0-oriented" particles nearby, making the reading unreliable. Higher-coercivity particles resist having their polarity changed this easily.) Physically, you can often format a double-density disk for 80 tracks (quad density), but the result will be a disk that has a tendency to lose data.

The DOS FORMAT program initializes (magnetically defines) the tracks and sectors. It also uses the first few sectors on the disk to write a boot record, a file allocation table (FAT), and the root directory. (At the option of the manufacturer, a second file allocation table may be written, in case the first becomes unreadable.)

The boot record is written by head 0, to track 0, sector 1, on every MS- or PC-DOS-formatted disk. (Heads are numbered starting with 0, tracks with 0, and sectors with 1.) There are two main parts to the boot record: a data area that describes the disk's characteristics and (if the disk is formatted as a boot disk) a short program in the boot record that begins the process of loading the DOS system files. (If the disk is not a boot disk, the small boot-record program just displays a message, waits for a keystroke, and calls on the BIOS to reboot.)

The file allocation table, or FAT, follows the boot record and maps the usage of the space on the disk in terms of clusters. On disks with more than 4,096 clusters, the FAT entries are 16 bits wide; otherwise they are 12 bits. Each entry tells DOS whether the cluster is available, reserved, bad, the last cluster in the file, or the next cluster in the file. The table shown in Fig-

DOS DISKETTE TYPES

Disk size	Capacity	Sides	Tracks/side	Sectors/track
5.25-inches	160K	1	40	8
5.25-inches	180K	1	40	9
5.25-inches	320K	2	40	8
5.25-inches	360K	2	40	9
5.25-inches	1.2MB	2	80	15
3.5-inches	720K	2	80	9
3.5-inches	1.44MB	2	80	18

Figure 1: Most of the seven types of floppy disks DOS recognizes are double density and can hold 40 tracks per side. The 80-track-per-side quad density disks use a higher-coercivity magnetic coating.

FILE ALLOCATION TABLE VALUES

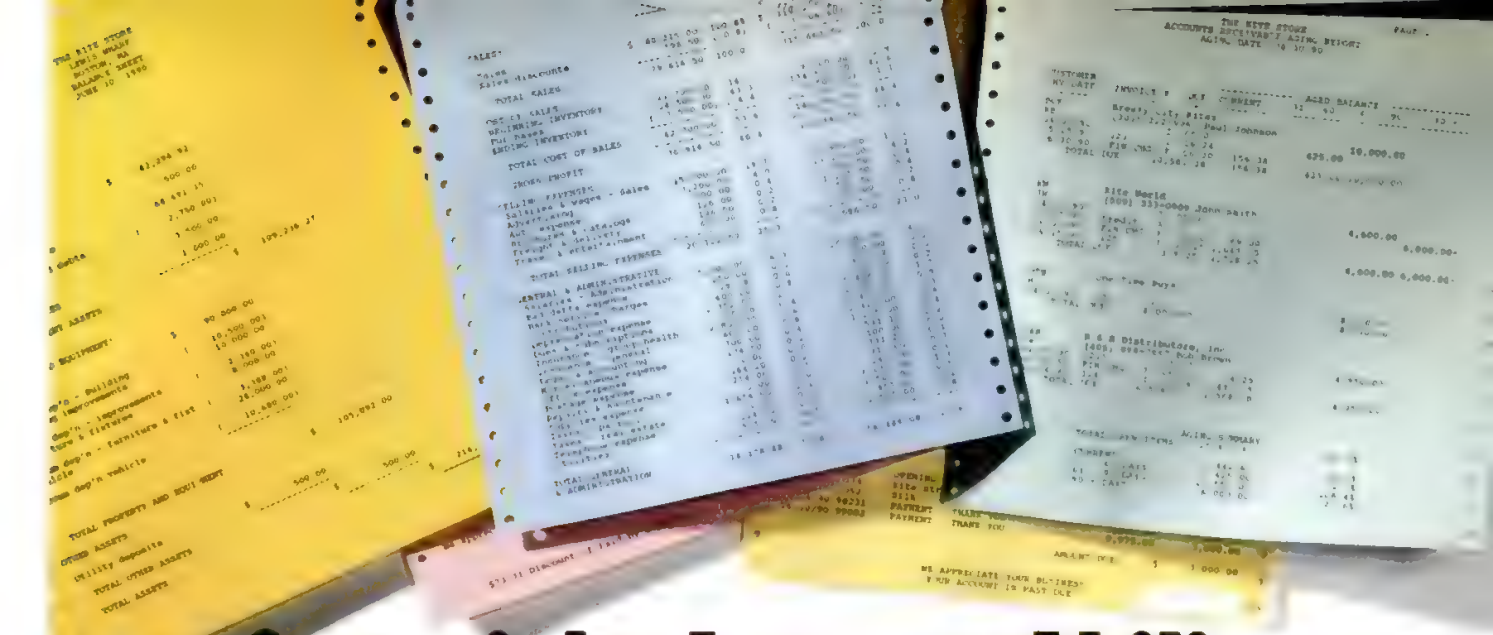
12-bit entry	16-bit entry	Description
000	0000	Cluster is available
001–FEF	0001–FFEF	The next cluster in the file
FF0–FF6	FFF0–FFF6	Cluster is reserved
FF7	FFF7	Bad cluster (marked by FORMAT)
FF8–FFF	FFF8–FFFF	Last cluster in the file

Figure 2: The file allocation table (FAT) provides an entry for each cluster on the disk. The 16-bit entries are used for disks that have more than 4,096 clusters.

ROOT DIRECTORY LAYOUT

Bytes	Length	Description
00–07	8	Filename
08–10	3	File extension
11–11	1	File attribute
12–21	10	Reserved
22–23	2	Time file was created or last updated
24–25	2	Date file was created or last updated
26–27	2	Cluster with which the file starts
28–31	4	File size

Figure 3: When reading a file, DOS finds the first cluster number from the root directory. Succeeding clusters for the same file are then found from the FAT.



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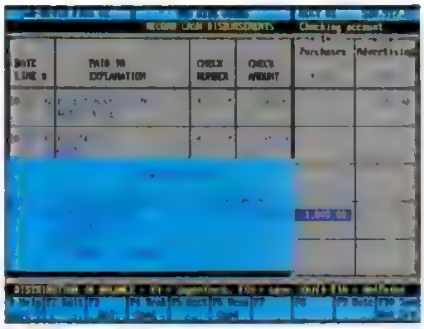

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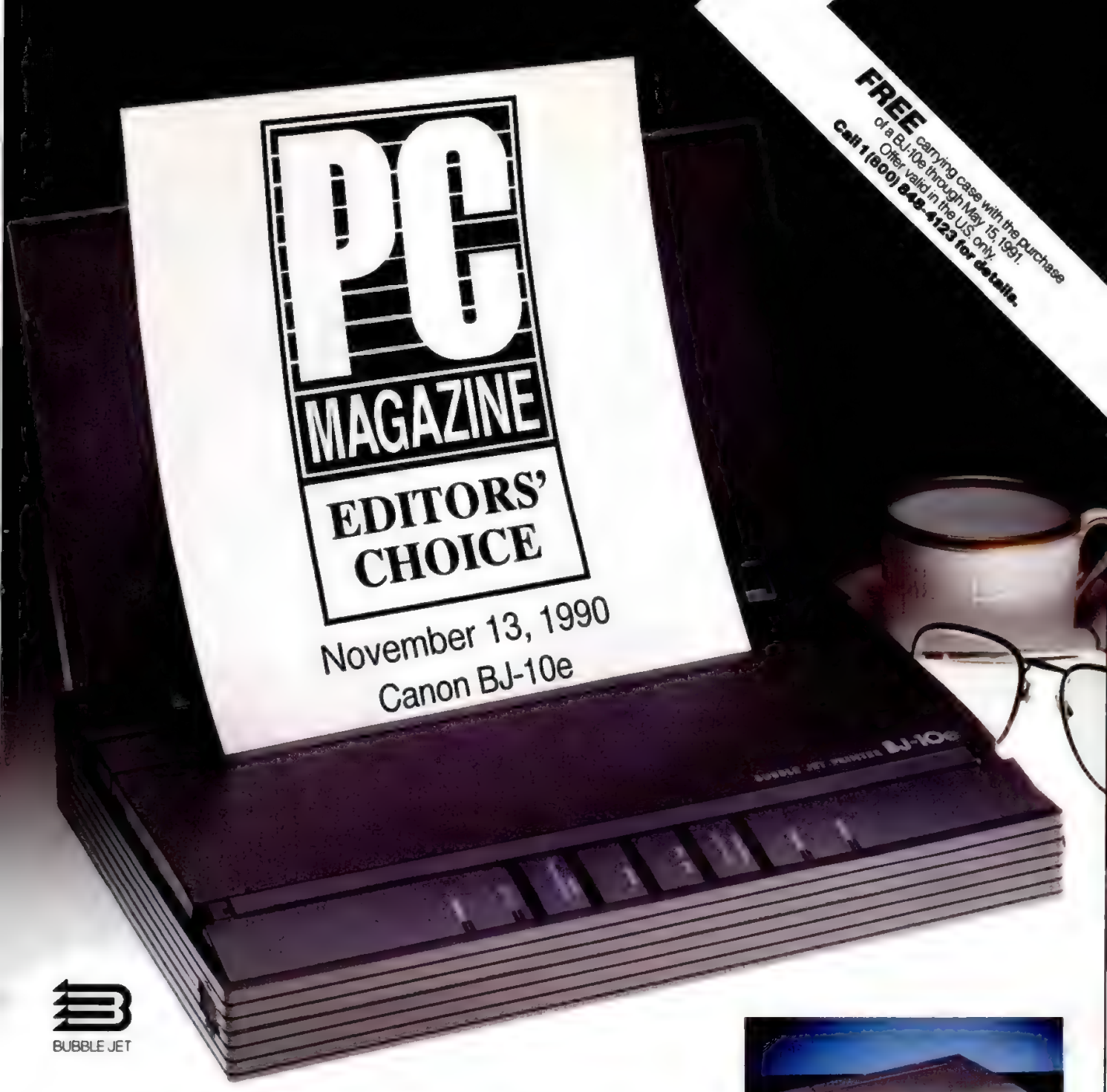

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ure 2 lists utilities the values (in hexadecimal) that a FAT entry can contain.

The root directory follows the FAT(s) and contains entries that hold information about the files and the subdirectories of the root directory on the disk. Figure 3 shows (in decimal) how the 32-byte entries in the root directory are used. The remainder of the disk (after the boot record, the FAT, and the root directory) is available for subdirectories and data files.

To read a file, DOS looks first in the directory for the starting cluster (bytes 26 and 27) and then to the entries in the FAT for the succeeding clusters that hold the file. DOS reads in the data from these clusters until it reaches the last entry, which will contain a value in the range (F)FF8h to (F)FFFh. Whenever DOS performs other disk operations, it updates the FAT and directory as needed. For example, when a file is deleted, the values in its FAT entries are changed to 0, and the first byte in its directory entry is changed to E5h.

FINDING YOUR WAY AROUND A DISK

Word processors and spreadsheet programs don't know how to read and write to a disk, of course. When you tell your program to load or save a file, the program simply asks DOS to do all this behind-the-scenes work. DOS in turn uses the BIOS (basic input/output system) to do the actual reading and writing.

COPY and XCOPY use DOS to read and write files by way of the directory and FAT. DISKCOPY doesn't, and neither do 2FILE and 2FLOPPY. These last three utilities do their copying sector by sector, track by track, bypassing DOS and using the BIOS to read the disk directly. This has its advantages and disadvantages.

The advantage is that by copying track by track, you save considerable time over the usual directory and FAT route. This is especially true if you must format the floppy disk before copying, as both DISKCOPY and 2FLOPPY do. The disadvantage is that if the disk has been fragmented by creating, copying, extending, and deleting files, the file fragmentation will be duplicated on the destination disk.

The easiest way to defragment the files on a floppy disk is to format a new diskette and use COPY *.* or XCOPY *.* /E. If you use COPY, you'll have to traverse each subdirectory manually; XCOPY used with the /E parameter copies subdirectories (both those that contain files and those that don't) in a single operation. Note that neither COPY or XCOPY will copy a volume label, though DISKCOPY and 2FLOPPY do.

If you're going to be using a utility such as ARC or *PKZIP* on the 2FILE file before sending it and you have previously stored and erased .ARC or .ZIP files on the floppy disk from which you're copying, you will *definitely* want to defragment the disk. The reason for this is that even after being deleted, the old files physically remain on the disk. (That's why unerase utilities such as the one in *The Norton Utilities* or *PC Tools* can work. Deleting a file marks the directory entry as not in use and updates the FAT, leaving the file itself intact.) If you've used the disk for ARCed or ZIPed files then, part of your 2FILE file will contain a lot of already compressed data. This won't hurt anything—the overall 2FILE will still be good—but the already-compressed sections won't compress down to as small a size as if you started with an unfragmented floppy.

HOW 2FILE WORKS

2FILE.EXE starts by verifying the command-line parameters. It then asks DOS interrupt 21h, function 1Ch for the size of the floppy disk. Both 2FILE and 2FLOPPY need to know the number of sectors per track and the size of each sector, and this function provides most of the information. There is no DOS or BIOS function that *directly* tells how many tracks a disk has. However, knowing the sizes of the various DOS floppy disks and that they will have either 40 or 80 tracks, the number of tracks can be calculated from the information supplied in the Media ID byte.

Every 2FILE file is an exact sector-by-sector copy of the original floppy disk, preceded by a 13-byte header. The first 3 bytes of the header are ASCII letters that identify the file (I used PCM, for *PC Magazine*). The remaining 10 bytes are contained in a structure that groups together various statistics about the original floppy disk, as shown in the C code excerpt of Figure 4.

After computing the size of the output file, 2FILE asks DOS if there is enough available space on the destination drive. If so, the program will ask you whether to proceed or not. If there isn't enough space, the program will tell you how many bytes the file needs and how much disk space is available, and then exit back to DOS.

After all of the error checking has been completed, it's a simple matter to read all of the floppy disk tracks and write them to the file.

HOW 2FLOPPY WORKS

After checking the command-line parameters and asking you to insert a floppy disk in the drive, 2FLOPPY starts by verifying the input file. Since you don't want to write out a non-2FILE file, 2FLOPPY looks at the file header for the signature letters (PCM). It then takes a look at the `drivenum`, `sides`, and the `numtracks` fields in the diskstats structure to see whether they fall within acceptable ranges. The last check is the file's size. 2FLOPPY first calculates how large the file should be and then asks DOS how large the file actually is. If the file is either too small or too large, we can assume that, although it might be a valid 2FILE file, it was probably corrupted somehow.

If the header doesn't match up, the file is either not a 2FILE file or it's one that has been corrupted and it's safer not to try the copying process. If this is the case, 2FLOPPY displays an error message and exits back to DOS.

If everything checks out, 2FLOPPY goes into its read-format-write-verify routine until all tracks in the file have been processed.

CTRL-BREAK AND CRITICAL ERRORS

Both 2FILE and 2FLOPPY have a Ctrl-Break handler. If you press Ctrl-Break during the course of the program, the program will stop, display a message, and ask

2FILE DISK PARAMETERS

```
struct diskstats { unsigned drivenum;  /* DOS drive#. 0=A... */
                   unsigned sides;     /* # of sides (heads) */
                   unsigned numtracks; /* # of tracks/side */
                   unsigned numsectors;/* # of sectors/track */
                   unsigned sectorsize;/* Bytes per sector */
                 };
```

Figure 4: The 13-byte header of a 2FILE source file contains the ASCII letters PCM and these statistics about the original floppy disk.

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PC UTILITIES UPDATES

Like all good software, the programs presented in *PC Magazine* are upgraded and improved. The only way to obtain the modified versions is to download them from PC MagNet. Here is a partial list of the programs that have been upgraded to fix minor bugs and system incompatibilities:

ALIAS.COM, Version 1.1
ANSI.COM, Version 1.3
BAT2EXEC.COM, Version 1.3
BCOPY, Version 1.2
BEN55.ARC (Benchmark Series, Version 5.5)
CARDFILE.COM, Version 1.1
CHKFRAG.EXE, Version 1.2
CMDEDIT.EXE, Version 2.1
CONFIG.CTL, Version 3.0
CONVERT.COM, Version 1.1
DIRMATCH.COM, Version 2.0
EMMA.COM, Version 2.2
EMS40.SYS, Version 1.1
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PCACCESS.COM, Version 1.1
PCMANAGE.EXE, Version 1.1
PCREMOTE.COM, Version 1.1
RN.COM, Version 2.0
SCHEDULE.COM, Version 1.1
SLICE.COM, Version 1.3
SNIPPER.COM, Version 1.2
ZCOPY.COM, Version 1.2

For a complete list of all the programs available from the PC MagNet Utilities Database, download UDCAT.ARC.

A downloadable index to *PC Magazine*'s product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine* Reviews Index for January 1988 to June 1990. It requires the search files in PCSRCH.EXE. Read the information file PCM.INF before you download any of these files.

The programs listed above are copyrighted. You may make copies as long as no charge is involved. But making copies for any commercial purpose is prohibited.

Photocopy this page. Trim and hole-punch the copy and add it to your manual.

2FILE and 2FLOPPY Commands

Steve Cooper — March 12, 1991 (Utilities)

Purpose: Creates an exact, sector-by-sector copy of a floppy disk as a single file on a hard disk for modem transmission or multiple floppy duplication (2FILE); writes (while formatting) and verifies such a stored file onto a diskette (2FLOPPY). 2FILE and 2FLOPPY support all 5.25-inch and 3.5-inch DOS diskette formats.

Format: `2FILE d: [e:][\path\]filename[.ext]`

Remarks: The *d:* parameter is the drive containing the floppy disk to be copied, and *filename* is the name to be given to the 2FILE copy. A default .FLP extension will be supplied if none is specified, and the currently logged hard disk drive and path will be used for storage, unless otherwise specified with the optional *e:* and *\path* parameters. The hard disk must have enough space to hold the contents of the floppy disk plus 13 bytes for a header.

Files created with 2FILE can be compressed before modem transmission with ARC, PKARC, PKZIP, and similar utilities. For maximum transmission speed, it is recommended that the files on the original floppy be defragmented, since (as with DISKCOPY) any existing file fragmentation will be preserved.

Format: `2FLOPPY d: [e:][\path\]filename[.ext] [/number] [/q] [/v]`

Remarks: The *d:* parameter is the drive containing the floppy disk to be formatted and written to. The *filename* is that of the 2FILE source file, which is assumed to be located on the currently logged hard disk and directory unless the *e:* or *\path* parameter is supplied. The 2FILE source is presumed to have the default .FLP extension unless an *.ext* is specified.

The optional */number* parameter is used when a number of floppy diskettes are to be made from the same 2FILE source. Values for */number* may range from 1 through 32,767 (default: 1). The user will be prompted with a message and a beep to insert new floppies as needed. To silence the beep, use the /q parameter. Copies are verified unless the /v parameter is specified. The /q and /v switches may be entered in either uppercase or lowercase.

you whether to continue or not. If you're running 2FILE and hit Ctrl-Break, the file it was writing will be erased before the program exits to DOS. If you stop 2FLOPPY, however, the floppy disk it was writing will be left in a state best called "incomplete." The reason for this lies in the formatting procedure.

Formatting a disk in DOS is a multistep process. First, markers for the tracks and sectors are written to the disk. Second, the boot record, FAT, and root directory are written to the disk. Third, if you specify the /S parameter, the last step—writing the system files—is executed. 2FLOPPY works a little differently. It calls the BIOS to format a track and then immediately writes the data it read from the 2FILE file. This step is repeated, one track after another, until all tracks are formatted and written. Thus, if you stop 2FLOPPY before it completes its task, the disk will not be completely formatted and written. No harm is done, but the disk will have to be reformatted (or written to with 2FLOPPY) before you can use it again.

Although there are other critical errors for other devices, both 2FILE and 2FLOPPY react only to disk drive errors; for example, when there's no disk in the drive or an open drive door. If these errors are encountered, a message will be displayed, asking you to fix the problem. You will also be asked whether to continue or stop the program. If the programs run into a critical error while reading and writing, however, you will be notified and they will exit to DOS. If 2FILE encounters a problem of this sort, it will delete the file it was writing prior to returning to DOS. I included this provision for safety's sake: if you replace a disk in the middle of a write operation, the program could attempt to write to a file that doesn't exist on the disk. If you replace a disk you're reading, the 2FILE file will not be useful in subsequent operations.

SAFETY FIRST

If you download and examine the C code for 2FLOPPY, you'll see that I put a check in the `format_track()` function. This verifies that the formatting is being done on a floppy disk, not on a hard disk. Any program that formats is potentially dangerous. If the function detects that you're trying to use 2FLOPPY on a hard disk, it returns with an error. Although the program checks for disk sizes and types earlier on, this function might be broken out of the program by someone and used in another application. Consequently, a second check is warranted.

A final point will be of interest to programmers. If you look carefully at the `read_sector()` and `write_sector()` routines and the support functions they call, you'll notice that I've put in a special check for disks that have more than 9 sectors per track. While the BIOS does a nice job with disk formats that use 9 sectors or less, it doesn't quite handle higher-density disks as well. If you ask the BIOS to read a track that has more than 9 sectors and the list of sectors you wish to read includes sector 9 *and* sector 10, the BIOS will report that a sector wasn't found, crashing the program. The simple fix for this BIOS problem is to read the track in two chunks, one with sectors 1 through 9, the second time around with sectors 10 through the last sector. ■

Stephen D. Cooper is an applications designer and programmer and is based in Walnut Creek, California.

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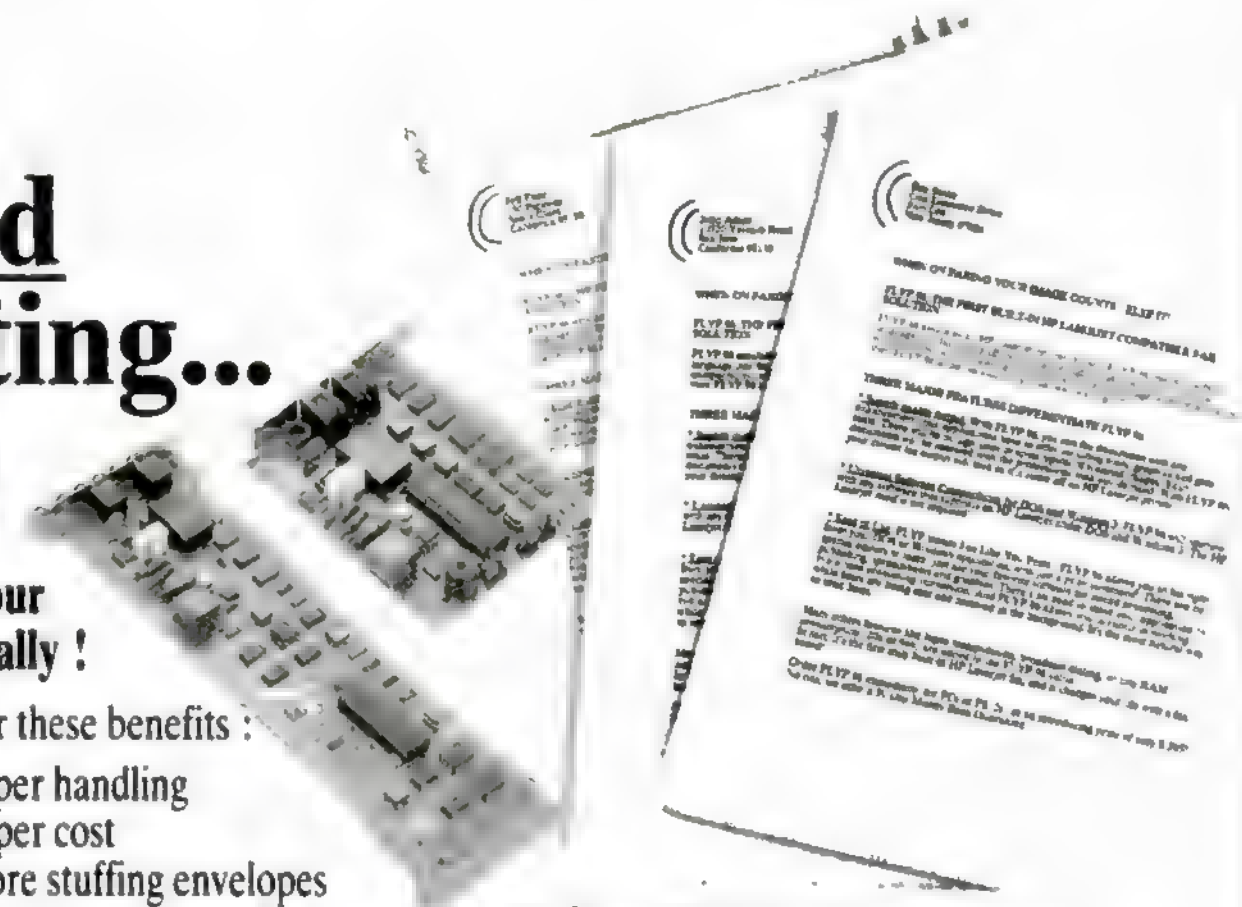

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PC MagNet News

The Latest Files and Features of PC Magazine's On-line Service

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Have you had trouble recalling the name of a specific utility offered through *PC Magazine* some time ago, or just been stuck while trying to take full advantage of the many programs on MagNet because you don't know where to start? Wouldn't it be nice to have a comprehensive listing that contains every file made available through PC MagNet's Utilities Database, complete with date of publication as well as a short description?

Such a catalog exists and is downloadable from PC MagNet. It's name is UDCAT.ARC, located in our Utilities Database (GO UTILITIES), and it is an up-to-date inventory of the files available to you since the very conception of *PC Magazine*'s Utility giveaways. Now you don't have to spend valuable on-line time searching for a file whose title you've forgotten. This complete directory puts every file at your fingertips.

Michael Dell Celebrity Forum a Success

We would like to thank Michael Dell, head of Dell Computer Corp., for hosting a successful week-long exchange on PC MagNet's Editorial Forum the week of December 8 to 15. Mr. Dell proved to be both insightful and openly participatory amid countless questions and grievances from our editors, SysOps, and a number of astute users.

If you would like to obtain the self-extracting file that contains a complete transcript of the useful conversation encountered and topics discussed, download DELL.EXE from DL0 of our Editorial Forum (GO EDITORIAL). Topics ranged from performance and pricing to the Asian market and the elusive DELL notebook. Download DELL .EXE. from DL0.

Who Is Orville Fudpucker?

Many people already know Orville as the virtual bartender in the Editorial Forum, the principal Sysop and resident enigma on MagNet, as well as moderator of one of the toughest MagNet discussion forums.

At home, Orville is also known as the proprietor of Grandma's Massage Parlor in beautiful downtown Plano, Texas, handling requests for Texas- sized jelly doughnuts. Orville also operates a 24-hour on-line Realtors service and is responsible for a minicomputer, four PCs, one portable, one laptop, and five turtles. He and his beautiful wife Prunella have also found the time to raise five grown children.

Orville has been a member of CompuServe since August of 1980. First active on their AVSIG forum, he discovered PC MagNet's Editorial Forum at message #14 (it is now at message #120,000+), and has been there ever since.

If you need any help in the editorial forum (GO EDITORIAL), drop Orville a note at 72241,150.

- **UDCAT.ARC:** Lists every PC Mag file ever published.
- **DELL.EXE:** Self-extracting transcript of Michael Dell forum.
- **SYSOP PROFILE:** Editorial Forum's own Orville Fudpucker.

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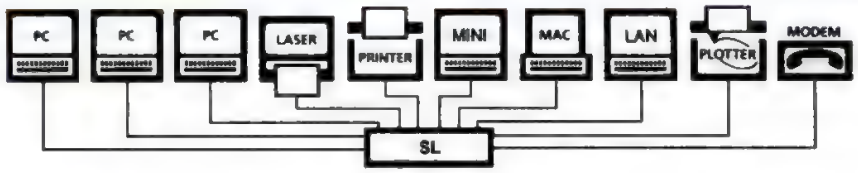

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CIRCLE 328 ON READER SERVICE CARD

by
Charles Petzold

Environments

Getting More Color With the Windows Palette Manager

In the last issue, we plunged headlong into working with the new palette manager supported under the *Microsoft Windows* 3.0 Graphics Device Interface (GDI). In this column, I'd like to discuss some of the details in a more methodical manner, as well as probe a little behind the scenes.

As you'll recall, most video adapters in common use today can simultaneously display only a limited number of colors in the high-resolution video mode required by *Windows*—16 colors in the case of the EGA and VGA, and 256 colors in the case of the IBM 8514/A and some Super VGA adapters. The number of simultaneous colors is governed by the number of bits per pixel stored in the video display buffer—4 for the EGA and VGA and 8 for the 8514/A and some Super VGA boards.

However, these video boards contain a palette lookup table that maps the pixel bits stored in the video buffer to RGB (red-green-blue) color values for display on the monitor. The *Windows* palette manager allows a *Windows* application to indirectly alter the palette lookup table on the video board in a device-independent manner, and hence select customized colors for use in drawing on its window.

The palette manager is intended mostly for video adapters that support more than 16 simultaneous colors in the video mode used by *Windows*. This excludes the standard IBM EGA and VGA, but includes the IBM 8514/A and some Super VGA adapters. Device drivers for video boards that support more than 16 simultaneous colors reserve 20 colors for system use. These are the colors that *Windows* uses for drawing title bars, menus, scroll bars, and the like.

The GRAYS program that I discussed in the last issue doesn't even bother to determine whether the device driver for the video board supports palette changes. The program works regardless of this on both the VGA and the 8514/A. When running on the VGA, the program displays 65 gray shades, all but a few of which are rendered with dithering. When the program runs on the 8514/A and uses the palette manager, 65 pure gray shades are displayed.

- With the *Windows* palette manager, a *Windows* application can alter the palette lookup table on a video board in a device-independent manner and thus select customized colors to use in its display.

QUERYING THE PALETTE SUPPORT

In most cases, a *Windows* application that wishes to use the palette manager should first determine whether or not the device driver supports it. You can do this by calling GetDeviceCaps using a device context handle for the video display and the RASTERCAPS parameter. The function returns an integer composed of a series of flags. You can then test palette support by performing a bitwise AND between the return value and the constant RC_PALETTE:

```
RC_PALETTE & GetDeviceCaps (hdc,
 RASTERCAPS)
```

If this value is nonzero, then the device driver for the video display supports palette manipulation. In that case, three other important items are also available from GetDeviceCaps. The function call

```
GetDeviceCaps (hdc, SIZEPALETTE)
```

returns the total size of the palette table on the video board. This is the same as the total number of colors that can be simultaneously displayed. For the 8514/A, this value is 256. This makes sense, because the 8514/A video buffer stores 8 bits per pixel.

The function

```
GetDeviceCaps (hdc, NUMRESERVED)
```

returns the number of colors in the palette table that the device driver reserves for system purposes—20 for the 8514/A. The 20 colors include black, white, dark, and light versions of the six additive and subtractive primaries, two gray shades, and four additional oddball colors. Without invoking the palette manager, these are the only pure colors a *Windows* application can use on the 8514/A.

These two values provided by GetDeviceCaps tell you that the 8514/A is capable of 256 colors, that 20 of them are reserved, and that a *Windows* application can use the palette manager functions to set the other 236 colors to whatever it wants.

One additional item is available:

```
GetDeviceCaps (hdc, COLORRES)
```

This value tells you the resolution (in bits) of the RGB color values loaded into the video board palette table. For the 8514/A, it is 18.

RGB colors in *Windows* are 24-bit values—8 bits each for the red, green, and blue intensities. However, some video boards may not be quite as precise. On the 8514/A, only 6 bits are used for the red, green, and blue intensities. Rather than 256 levels of red, green, and blue, the 8514/A is capable of only 64.

It's useful for a *Windows* program to examine this color resolution value and act accordingly. If, for example, the color resolution is 18, it makes no sense for a program to request 128 shades of gray, because only 64 discrete shades of gray are possible. Requesting 128 shades of gray will unnecessarily fill the video board palette table with redundant entries.

THE SYSTEM PALETTE

Device drivers that support palette manipulation maintain a table of 24-bit RGB color values known as the *system palette*. This table corresponds directly to the RGB color values currently loaded in the palette lookup table on the video adapter board. (However, the hardware palette lookup table may have a lower color resolution than the system palette.)

A program can obtain any or all the RGB entries in the system palette by calling

```
GetSystemPaletteEntries (hdc,
 wStart, wNum, &pe) ;
```

This function works only if the video adapter device driver supports palette manipulation. The last parameter is a pointer to a structure of the type PALETTEENTRY. As I discussed in the last issue, this structure is defined as follows:

```
typedef struct
 {
 BYTE peRed ;
 BYTE peGreen ;
 BYTE peBlue ;
 BYTE peFlags ;
 }
 PALETTEENTRY ;
```

You can use this function in several ways. A program can define one PALETTEENTRY structure like this:

```
PALETTEENTRY pe ;
```

and then call GetSystemPaletteEntries multiple times, like so:

```
GetSystemPaletteEntries (hdc,
 wEntry, 1, &pe) ;
```

where `wEntry` ranges from 0 to 1 less than the value returned from GetDeviceCaps with the SIZEPALETTE index (for example, from 0 to 255 for the 8514/A).

Or a program can obtain all the system palette entries by defining a pointer to a PALETTEENTRY structure:

```
PALETTEENTRY *ppe ;
```

and then allocating a block of memory sufficient to hold as many PALETTEENTRY structures as indicated by the size of the palette (256 for the 8514/A). You call the function once like this:

```
GetSystemPaletteEntries (hdc, 0,
 wNum, ppe) ;
```

On return, `ppe` points to an array of PALETTEENTRY structures that contain the entire system palette.

Or a program can obtain any range of palette entries by setting the second and third parameters accordingly. (Note that these parameters are defined as WORD values—16-bit unsigned integers. Apparently the *Windows* developers don't anticipate a system palette containing more than 65,535 entries.)

The GetSystemPaletteEntries function lets you examine the video hardware palette table as closely as possible in *Windows*. The entries in the system palette are in the order of increasing values of the pixel-bits used to denote color in the video display buffer.

THE LOGICAL PALETTE

A *Windows* program can change the system palette, but only indirectly. The first step is to create a *logical palette*, which is basically an array of RGB color values that the program wants to use. The logical palette is a GDI "object" not immediately associated with a particular device context. As you saw in the last column, you create a logical palette like this:

```
hPal = CreatePalette (&lp) ;
```

The single parameter is a LOGPALETTE structure, which contains a version number, the number of entries in the logical palette, and an array of PALETTEENTRY structures that defines the RGB color values in the logical palette. The function returns a handle to the logical palette.

Bear in mind that this function does not cause any change to the system palette or the palette table on the video board. The logical palette must be selected into a device context and realized before anything happens, as I'll discuss shortly.

A program can query the RGB color values in a logical palette by calling

```
GetPaletteEntries (hPal, wStart,
 wNum, &pe) ;
```

You can use this function in the same way as GetSystemPaletteEntries. But note that the first parameter is a handle to the logical palette rather than a handle to a device context.

A corresponding function lets you change values in the logical palette after it has been created:

```
SetPaletteEntries (hPal, wStart,
 wNum, &pe) ;
```

Again, keep in mind that calling this function doesn't cause any change to the system palette—even if the palette is currently selected in a device context. The function can't change the size of the logical palette. If you need to change the palette size, use ResizePalette (hPal, nSize).

The following function accepts an RGB color reference value as the last parameter and returns an index into the logical palette that corresponds to the RGB color value that most closely approximates it:

```
wIndex = GetNearestPaletteIndex
 (hPal,  cr) ;
```

If you wish, you can then obtain the actual RGB color value in the logical palette by calling GetPaletteEntries.

The logical palette can be deleted by calling

```
DeleteObject (hPal) ;
```

Any logical palettes a program creates should be deleted before the program terminates.

SELECTING AND REALIZING

To *use* the color values in the logical palette, you must first select it into a device context:

```
SelectPalette (hdc, hPal,
 bBackground) ;
```

This function is roughly equivalent to the SelectObject function used for selecting logical pens, brushes, bitmaps, regions, and fonts into device contexts, and it doesn't really do very much except make the logical palette available for later use. SelectPalette returns a handle to the logical palette previously selected in the device context. (I'll discuss the last parameter to SelectPalette shortly.)

The function that does much of the work in altering the system palette is

```
RealizePalette (hdc) ;
```

The SelectPalette and RealizePalette functions are generally called in succession. RealizePalette loads the RGB color values found in the logical palette into the system palette and consequently into the hardware palette table on the video board. This function also returns the number of system palette entries that have changed.

But it's not quite that simple. As I discussed in the last issue, the problem is that all programs running under *Windows* share the video display and hence the same video hardware palette and the same system palette. These programs may be using different logical palettes. Indeed, the number of colors in all the different logical palettes selected into a video device context by all the programs running under *Windows* may exceed the size of the system palette. *Windows* solves this problem by giving the foreground window the highest priority.

When a program calls RealizePalette, *Windows* broadcasts a WM_PALETTE CHANGED message to all windows, beginning with the foreground window. Generally, any program that uses a customized palette also calls SelectPalette and RealizePalette. This allows the foreground window to have priority.

When subsequent windows call RealizePalette during the WM_PALETTE CHANGED message, *Windows* first checks for matches of RGB colors in the logical palette with RGB colors already loaded in the system palette. If two programs need the same color, the same system palette entry is used for both. Next, *Windows* checks for unused system palette entries. If none exist, then the color in the logical palette is mapped to the closest color from the 20 reserved entries.

If the last parameter to SelectPalette is set to FALSE, then the palette is always a background palette, which means that it gets whatever unused entries still exist in the system palette after all other programs have realized their palettes.

Another palette-related message is WM_QUERYNEWPALETTE, which a window receives when it's about to become the active window. This allows the active window first dibs on the system palette. I discussed how to process both of these messages in the last issue.

If you want to preserve some degree of visual integrity when your program is in the background, then you should place the most important entries in the logical palette first.

The only pure colors that a *Windows* program may use are the 20 reserved colors and the colors in its logical palette (after the logical palette has been selected into the device context and realized). To use these colors, you designate them with the PALETTERGB macro (to specify colors using red, green, and blue intensities) or the PALETTEINDEX macro (to specify colors based on an index into the logical palette). If you use the RGB macro, you'll continue to produce dithered colors formed from the 20 reserved colors.

THE ORDERING PROBLEM

If the system palette doesn't contain enough entries for a whole logical palette (which may well be the case, if the logical palette belongs to a program running in the background) then GDI attempts to map as many colors as possible into the system palette, starting with the beginning of the logical palette. This implies that if you want to preserve some degree of visual integrity when your program is in the background, then you should place the most important entries in the logical palette first.

For the GRAYS program discussed in the last issue, this is a bit of a problem. The most important gray shades are those resulting when red, green, and blue intensities are set to 00 (black), 80, and FF (white). The second most important gray shades are the two that fall in between: 40 and C0. The next four fall midway between the others: 20, 60, A0, and E0, and the level after that follows suit: 10, 30, 50, 70, 90, B0, D0, and F0. I think you see how this progression works.

It was convenient for GRAYS to load sequential gray-shade levels and then use the PALETTEINDEX macro to specify the level of gray. This wouldn't work if the RGB color values in the logical palette were not ordered sequentially.

SYSTEM PALETTE USE

Two of the most mysterious palette functions in *Windows* 3.0 are GetSystemPaletteUse and SetSystemPaletteUse. I suspect these functions haven't been used much yet. Indeed, the *Windows Programmer's Reference* indicates that GetSystemPaletteUse has one parameter (a handle to a device context) while WINDOWS.H indicates it has two parameters. (WINDOWS.H is wrong.)

I mentioned earlier that a device driver that supports palette manipulation reserves 20 entries in the system palette. A program can use SetSystemPaletteUse to get access to 18 of these 20 entries. By default, the GetSystemPaletteUse function returns 1, which corresponds to the identifier SYSPAL_STATIC and means that the reserved colors will not change when a program realizes its logical palette.

If a program calls SetSystemPaletteUse with the parameter SYSPAL_NOSTATIC, then the only reserved colors are black and white. The other 18 reserved entries in the system palette can be changed when a program realizes its logical palette. For a 256-color device like the 8514/A, this gives the program the ability to set 254 custom colors rather than 236.

But this can render system colors used in title bars, menus, and so forth nonsensical. Menus, for instance, can become unreadable. For this reason, the *Windows Programmer's Reference* advises that system colors use combinations of black and white. Directions for using SetSystemPaletteUse can be found in the documentation for the function. This takes a bit of work, but it

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THE RASTER-OP PROBLEM

As you may already know, the *Windows* GDI allows you to draw lines and filled areas using various drawing modes, or *raster operations*. You set the drawing mode you want using SetROP2. (The 2 indicates a binary raster operation between two objects; tertiary raster operations are used with BitBlt and other similar functions.) These raster operations determine how the pixels of the object you're drawing combine with the pixels of the surface. For example, you can draw a line so that the pixels of the line are combined with the pixels of the display, using a bitwise exclusive-OR operation.

The raster operations work by performing bitwise operations on pixel bits. On 16-color devices such as the VGA, the pixel bits stored in video memory correspond to color in a consistent manner, so that the effects of raster operations are clearly defined. However, changing the palette can affect these raster operations considerably. The raster operations work on pixel bits, and these pixel bits may have no relationship to actual colors.

You can see this for yourself by running the GRAYS program from the last issue on an 8514/A and selecting one of the menu options that causes the program to use the palette manager. Now make the window shorter by dragging the bottom sizing border up. When you drag the sizing border, *Windows* displays the effect by using a raster operation that inverts the background pixel bits. The intent is to make the dragged sizing border always visible. But with the GRAYS program, you'll probably see various random colors instead. These colors happen to correspond to unused entries in the palette table that result from inverting the pixel bits of the display. The visible color is not being inverted—only the pixel bits.

The 16 standard reserved colors are placed at the top and bottom of the system palette so that the results of raster operations are still normal. However, once you begin changing the palette—and particularly if you take over the reserved colors—then raster operations of color objects can become meaningless. The only guarantee you have is that the raster operations will work with black and white. Black is the first entry in the system palette (all pixel bits set to 0) and white is the last entry (all pixel bits set to 1). These entries cannot be changed.

If you need to predict the results of raster operations on color objects, you can do so by getting the system palette table and looking at the RGB color values for the various pixel-bit values.

PALETTE ANIMATION

At this point, I've discussed all of the palette manager functions contained in *Windows* 3.0, with one exception—AnimatePalette. This function allows a program to perform some rudimentary animation, using the palette. This can be a lot of fun; I've already written five small sample programs that demonstrate how palette animation works. I'll discuss the first of them in the next issue. ■

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CIRCLE 172 ON READER SERVICE CARD

by
Ray Duncan

Power Programming

Creating a DPMI-Based DOS Extender Of Your Own

Life isn't easy for the authors of commercial DOS extenders these days. Their products must be capable of running on a completely standalone basis, taking full control of the 286, 386, and 486 processors in protected mode, and maintaining all the special CPU control registers, descriptor tables, and page tables. And their brainchildren must also be able to coexist harmoniously with memory managers or device drivers that implement any of the existing protocols or standards for extended memory allocation—be it top-down (INT 15h), bottom-up (VDISK), XMS (HIMEM.SYS), VCPI (*QEMM-386* or *386MAX*), or DPMI (*Microsoft Windows* 3.0). Developers of DOS extenders must also be masters of the various PC hardware architectures, with all their peculiarities and ramifications for mode switching, toggling of the A20 address line, and the like. This certainly isn't a job description I'd envy, even if it does carry its own unique rewards (the staff of Phar Lap Software has been growing, I suspect, as quickly as the Microsoft OS/2 development staff has been shrinking).

But DOS extenders are a technologically fascinating topic, and fortunately events have conspired to place a low-cost test-bed for DOS extender experimentation at our disposal. I refer, of course, to the implementation of the DOS Protected Mode Interface (DPMI) in *Windows* 3.0. First, let's review how "real" DOS extenders work, and then we'll implement a simple little DPMI-based DOS extender of our own.

- DOS extenders are technologically fascinating and, luckily, the *Windows* 3.0. implementation of the DOS Protected Mode Interface gives us a low-cost test-bed for DOS extender experimentation.

THE TWO FACES OF A DOS EXTENDER

A typical DOS extender that you might buy from Phar Lap or Rational Systems can be thought of as having two main sections: an initialization component and an interrupt handler component. The initialization portion of a DOS extender gains control of the machine when the DOS extender is loaded by DOS in real mode as a result of a user command or an INT 21h, function 4Bh (EXEC) function call by another program. In most cases, the DOS extender and the protected-mode application (such as *Mathematica*, *AutoCAD*, or *Lotus 1-2-3*, Release 3.0) are bound together in the same .EXE file. However, the only part of the file visible to DOS is the DOS extender, because it's the only part described by the .EXE file header and relocation table.

The initialization routine has a lot of work to do before the protected-mode application can start running. It must probe the environment and determine whether it's running on the bare hardware (aside from DOS) or in the presence of one of the several species of memory managers. It must allocate some extended memory and load the application's code and data, performing any necessary relocations and fixups. It must allocate additional conventional memory (memory below 640K) for communication with MS-DOS and the ROM BIOS. It must build the necessary global and local descriptor tables to support protected-mode addressing, which includes mapping some descriptors onto "magic" memory areas like the PSP, the environment block, the video refresh buffer, and the ROM BIOS data area, for the convenience of the application. It must switch the CPU from real mode into protected mode. And it must take full command of the CPU's interrupt subsystem by building an interrupt descriptor table, reprogramming the 8259 interrupt controllers, and installing handlers for every type of interrupt that might occur in protected mode.

From the DOS extender's point of view, there are three types of interrupts to worry about. The first group consists of the CPU faults or exceptions, usually caused by a program error but sometimes by a hardware error (for example, a nonmaskable interrupt due to a RAM parity error) or an unexpected result on the numeric coprocessor. The second group consists of the external hardware interrupts—signals that a peripheral device has received data, is ready to accept more data, or has encountered some other condition that needs attention. The third group are the software interrupts, which occur when an application program executes an INT instruction. Control over software interrupts is a particularly crucial aspect of DOS extender initialization, because it allows the DOS extender to function transparently by intercepting the application's requests for ROM BIOS and MS-DOS services.

The exact order in which the DOS extender will perform these initialization chores depends in part on the philosophy of the implementer and in part on the

environment in which the DOS extender will run. For example, XMS and VCPI memory managers require that the DOS extender make its memory allocation calls in real mode, while requests to a DPMI host for memory must be made in protected mode. Similarly, techniques for mode switching differ with the PC architecture (PC/AT, PS/2, and so forth) and with the presence or absence of XMS, VCPI, and DPMI. The only things we can say for sure about the initialization sequence are that a minimal global descriptor table (GDT) must be constructed in real mode and that the CPU must be in protected mode before control passes to the entry point of the actual application program.

Once the application is launched, the DOS extender's initialization section is dead code; the memory it occupies can be reclaimed and reused. The application's code now becomes the center of the action. The remaining parts of the DOS extender are activated only upon the occurrence of one of the three kinds of interrupts listed earlier. In this respect, the DOS extender is much like a real-mode terminate-and-stay-resident (TSR) program. But the DOS extender's status after initialization is somewhat more slippery than that of your average TSR.

From MS-DOS's perspective, the DOS extender is the only program that's running, and it's a perfectly ordinary program at that: it lives in the memory that MS-DOS allocated for it, and it makes normal MS-DOS function calls. From the protected-mode application's point of view, the DOS extender is nearly invisible (in fact, the more invisible, the better the DOS extender); the application requests MS-DOS and ROM BIOS services by executing the usual software interrupts, and somehow the right things happen—even though the interrupts are being executed in protected mode and the application is passing virtual addresses of data and buffers lying in extended memory.

The fully initialized DOS extender can be thought of simply as a grab bag of interrupt service routines.

Looking at the DOS extender from the inside out (the viewpoint of its author), the fully initialized DOS extender can be thought of rather simply as a grab bag of interrupt service routines.

When a CPU fault or exception occurs, the DOS extender usually has little recourse but to terminate the protected mode application, unless the application has explicitly registered its own handler for the interrupt. If the application has gone so far awry as to cause a stack underflow or general protection (GP) fault, for example, it's obviously ailing and will only cause more trouble if it's allowed to continue. (Interpreters and debuggers are obvious exceptions.)

External hardware interrupts are treated differently. If the protected-mode application hasn't registered a handler, the interrupt is "reflected" to the original real-mode owner of the interrupt. In other words, the DOS extender fields the inter-

TINYDOSX.ASM — 1 of 4

```
        title   TINYDOSX DPMI-Based Tiny DOS Extender
        page    55,132

; TINYDOSX.ASM  Tiny DPMI-Based DOS Extender
; Copyright (C) 1990 Ziff Davis Communications
; PC Magazine * Ray Duncan

stdin   equ     0                       ; standard input handle
stdout  equ     1                       ; standard output handle
stderr  equ     2                       ; standard error handle
cr      equ     0dh                     ; ASCII carriage return
lf      equ     0ah                     ; ASCII line feed

DGROUP  group   _DATA

_DATA   segment word public 'DATA'

modesw  dd      0                       ; far pointer to DPMI mode
                                        ;   switch entry point
int0dv  dd      0                       ; address of previous
                                        ;   GP fault handler
int21v  dd      0                       ; address of previous
                                        ;   Int 21H handler
realseg dw      0                       ; segment of real mode buffer
realsel dw      0                       ; selector for real mode buffer

gpfmsg  db      cr,lf,lf
        db      'TINYDOSX: general protection fault!'
        db      cr,lf
gpfmsg_len equ  $-gpfmsg

abmsg   db      cr,lf,lf
        db      'TINYDOSX: unsupported DOS function!'
        db      cr,lf
abmsg_len equ   $-abmsg

regs    label   word                    ; real mode register structure
                                        ; for DPMI translation services
regDI   label   word                    ; 00H DI or EDI
regEDI  dd      0
regSI   label   word                    ; 04H SI or ESI
regESI  dd      0
regBP   label   word                    ; 08H BP or EBP
regEBP  dd      0
        dd      0                       ; 0CH (reserved)
regBX   label   word                    ; 10H BX or EBX
regEBX  dd      0
regDX   label   word                    ; 14H DX or EDX
regEDX  dd      0
regCX   label   word                    ; 18H CX or ECX
regECX  dd      0
regAX   label   word                    ; 1CH AX or EAX
regEAX  dd      0
cpuFLAGS dw     0                       ; 20H cpu status flags
regES   dw      0                       ; 22H ES
regDS   dw      0                       ; 24H DS
regFS   dw      0                       ; 26H FS
regGS   dw      0                       ; 28H GS
regIP   dw      0                       ; 2AH IP (CS:IP ignored by
regCS   dw      0                       ; 2CH CS  DPMI function 0300H)
regSP   dw      0                       ; 2EH SP (SS:SP=0 to have DPMI
regSS   dw      0                       ; 30H SS  host supply a stack)

protDX  dw      0                       ; save protected mode DX
protSI  dw      0                       ; save protected mode SI
protES  dw      0                       ; save protected mode ES

dispatch label  word                    ; Int 21H dispatch table
        dw      offset _TEXT:fxn00h     ; fxn 00H terminate
        dw      offset _TEXT:fxn01h     ; fxn 01H char input+echo
        dw      offset _TEXT:fxn02h     ; fxn 02H char output
        dw      offset _TEXT:fxn03h     ; fxn 03H aux input
        dw      offset _TEXT:fxn04h     ; fxn 04H aux output
        dw      offset _TEXT:fxn05h     ; fxn 05H printer output
        dw      offset _TEXT:fxn06h     ; fxn 06H raw console I/O
        dw      offset _TEXT:fxn07h     ; fxn 07H raw input no echo
        dw      offset _TEXT:fxn08h     ; fxn 08H char input no echo
        dw      offset _TEXT:abort      ; fxn 09H
        dw      offset _TEXT:abort      ; fxn 0AH
        dw      offset _TEXT:fxn0bh     ; fxn 0BH input status
        dw      offset _TEXT:abort      ; fxn 0CH
        dw      offset _TEXT:fxn0dh     ; fxn 0DH disk reset
        dw      offset _TEXT:fxn0eh     ; fxn 0EH select disk
        dw      offset _TEXT:abort      ; fxn 0FH
        dw      offset _TEXT:abort      ; fxn 10H
        dw      offset _TEXT:abort      ; fxn 11H
        dw      offset _TEXT:abort      ; fxn 12H
        dw      offset _TEXT:abort      ; fxn 13H
        dw      offset _TEXT:abort      ; fxn 14H
        dw      offset _TEXT:abort      ; fxn 15H
        dw      offset _TEXT:abort      ; fxn 16H
        dw      offset _TEXT:abort      ; fxn 17H
        dw      offset _TEXT:abort      ; fxn 18H
        dw      offset _TEXT:fxn19h     ; fxn 19H get current drive
        dw      offset _TEXT:abort      ; fxn 1AH
        dw      offset _TEXT:fxn1bh     ; fxn 1BH get cur. drive data
        dw      offset _TEXT:fxn1ch     ; fxn 1CH get drive data
        dw      offset _TEXT:abort      ; fxn 1DH
        dw      offset _TEXT:abort      ; fxn 1EH
        dw      offset _TEXT:abort      ; fxn 1FH
        dw      offset _TEXT:abort      ; fxn 20H
        dw      offset _TEXT:abort      ; fxn 21H
        dw      offset _TEXT:abort      ; fxn 22H
        dw      offset _TEXT:abort      ; fxn 23H
        dw      offset _TEXT:abort      ; fxn 24H
        dw      offset _TEXT:abort      ; fxn 25H
        dw      offset _TEXT:abort      ; fxn 26H
        dw      offset _TEXT:abort      ; fxn 27H
        dw      offset _TEXT:abort      ; fxn 28H
        dw      offset _TEXT:abort      ; fxn 29H
        dw      offset _TEXT:fxn2ah     ; fxn 2AH get date
        dw      offset _TEXT:fxn2bh     ; fxn 2BH set date
        dw      offset _TEXT:fxn2ch     ; fxn 2CH get time
```

Figure 1: Here's the source code for a skeleton DPMI 0.9-based DOS extender that can be linked with small-model C programs.

rupt, saves the CPU state, switches the CPU into real mode, and reissues the interrupt with an INT instruction. When the real-mode handler executes an interrupt return (IRET), the DOS extender recovers control, switches the CPU back into protected mode, restores the CPU state, and then issues its own IRET so that the application can continue.

Which brings us to the last category of interrupt that the DOS extender must dispose of: interrupts that are explicit MS-DOS or ROM BIOS function requests by the application. There are a number of different software interrupts that the DOS extender must be prepared to cope with: MS-DOS's INT 20h through INT 2Fh, the ROM BIOS video driver INT 10h, serial port driver INT 14h, keyboard driver INT 16h, printer driver INT 17h, Microsoft Mouse driver INT 33h, and so on. Each one of these interrupts provides a pathway to a host of different subfunctions, typically selected by a value in register AH. For instance, more than 80 functions (both documented and undocumented) are defined for INT 21h. As I explained in the last column, these functions can be divided into four classes:

- functions that require little more than a mode switch before passing them down to MS-DOS or the ROM BIOS;
- functions that address application buffers and therefore require data movement and address translation before they can be reissued to MS-DOS or the ROM BIOS;
- functions that must be completely replaced to make them meaningful in protected mode; and
- function calls that are unique to the DOS extender itself and provide special services that have no equivalents in MS-DOS or the ROM BIOS.

In any event, the DOS extender's handling of an MS-DOS or ROM BIOS service request is easy to visualize.

There is also an implicit fifth class of functions, which I didn't mention previously: the MS-DOS functions that the DOS extender author simply chooses not to support because they're either too dangerous or not worth the hassle. The FCB file functions, the direct disk I/O functions, and some of the undocumented DOS functions that vary tremendously from one version of DOS to another are good examples.

In any event, the DOS extender's handling of an MS-DOS or ROM BIOS service request is easy to visualize. An umbrella routine is entered first; it saves the CPU flags and all the general and segment registers for later reference. The umbrella routine then decodes the function request by using the function number in AH as an index into a jump table, and then passes control to a handler that is specific to the function type. Functions that pass all parameters in registers and don't reference data in extended memory can fall through to another umbrella handler that performs the necessary mode switching and reissues the interrupt in real mode. Nearly all functions that pass addresses of buffers or pass parameters by reference must be handled on an individual basis, because there's regrettably little symmetry of structures or register usage across DOS and ROM BIOS function calls. Of course, memory management

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```
        dw      offset _TEXT:fxn2dh     ; fxn 2DH set time
        dw      offset _TEXT:fxn2eh     ; fxn 2EH set verify flag
        dw      offset _TEXT:abort      ; fxn 2FH
        dw      offset _TEXT:fxn30h     ; fxn 30H get DOS version
        dw      offset _TEXT:abort      ; fxn 31H
        dw      offset _TEXT:abort      ; fxn 32H
        dw      offset _TEXT:fxn33h     ; fxn 33H get/set break flag
        dw      offset _TEXT:abort      ; fxn 34H
        dw      offset _TEXT:abort      ; fxn 35H
        dw      offset _TEXT:fxn36h     ; fxn 36H get drive info
        dw      offset _TEXT:abort      ; fxn 37H
        dw      offset _TEXT:error      ; fxn 38H
        dw      offset _TEXT:fxn39h     ; fxn 39H create directory
        dw      offset _TEXT:fxn3ah     ; fxn 3AH delete directory
        dw      offset _TEXT:fxn3bh     ; fxn 3BH select directory
        dw      offset _TEXT:fxn3ch     ; fxn 3CH create file
        dw      offset _TEXT:fxn3dh     ; fxn 3DH open file
        dw      offset _TEXT:fxn3eh     ; fxn 3EH close file
        dw      offset _TEXT:fxn3fh     ; fxn 3FH read file
        dw      offset _TEXT:fxn40h     ; fxn 40H write file
        dw      offset _TEXT:fxn41h     ; fxn 41H delete file
        dw      offset _TEXT:fxn42h     ; fxn 42H seek
        dw      offset _TEXT:fxn43h     ; fxn 43H get/set attributes
        dw      offset _TEXT:error      ; fxn 44H
        dw      offset _TEXT:fxn45h     ; fxn 45H dup handle
        dw      offset _TEXT:fxn46h     ; fxn 46H redirect handle
        dw      offset _TEXT:fxn47h     ; fxn 47H get cur. directory
        dw      offset _TEXT:error      ; fxn 48H
        dw      offset _TEXT:error      ; fxn 49H
        dw      offset _TEXT:error      ; fxn 4AH
        dw      offset _TEXT:error      ; fxn 4BH
        dw      offset _TEXT:fxn4ch     ; fxn 4CH terminate
        dw      offset _TEXT:abort      ; fxn 4DH
        dw      offset _TEXT:error      ; fxn 4EH
        dw      offset _TEXT:error      ; fxn 4FH
        dw      offset _TEXT:abort      ; fxn 50H
        dw      offset _TEXT:abort      ; fxn 51H
        dw      offset _TEXT:abort      ; fxn 52H
        dw      offset _TEXT:abort      ; fxn 53H
        dw      offset _TEXT:fxn54h     ; fxn 54H get verify flag
        dw      offset _TEXT:abort      ; fxn 55H
        dw      offset _TEXT:error      ; fxn 56H
        dw      offset _TEXT:fxn57h     ; fxn 57H get/set file date
        dw      offset _TEXT:error      ; fxn 58H
        dw      offset _TEXT:abort      ; fxn 59H
        dw      offset _TEXT:fxn5ah     ; fxn 5AH create temp file
        dw      offset _TEXT:fxn5bh     ; fxn 5BH create unique file
        dw      offset _TEXT:fxn5ch     ; fxn 5CH lock/unlock
        dw      offset _TEXT:abort      ; fxn 5DH
        dw      offset _TEXT:error      ; fxn 5EH
        dw      offset _TEXT:error      ; fxn 5FH
        dw      offset _TEXT:abort      ; fxn 60H
        dw      offset _TEXT:abort      ; fxn 61H
        dw      offset _TEXT:abort      ; fxn 62H
        dw      offset _TEXT:error      ; fxn 63H
        dw      offset _TEXT:abort      ; fxn 64H
        dw      offset _TEXT:error      ; fxn 65H
        dw      offset _TEXT:error      ; fxn 66H
        dw      offset _TEXT:error      ; fxn 67H
        dw      offset _TEXT:fxn68h     ; fxn 68H commit file
        dw      offset _TEXT:abort      ; fxn 69H
        dw      offset _TEXT:abort      ; fxn 6AH
        dw      offset _TEXT:abort      ; fxn 6BH
        dw      offset _TEXT:error      ; fxn 6CH
        dw      offset _TEXT:abort      ; fxn 6DH
        dw      offset _TEXT:abort      ; fxn 6EH
        dw      offset _TEXT:abort      ; fxn 6FH

DATA    ends

_TEXT   segment byte public 'CODE'

        assume  cs:_TEXT,ds:DGROUP

; Initialization routine for the Tiny DOS Extender.  First we test for
; the presence of a DPMI host, get the address of the mode switch entry
; point, and request the switch to protected mode.  Then we install
; a handler for GP faults to circumvent the Win 3 brain-damaged dialog
; box, and allocate some memory below 1 MB to use as a buffer for
; communication with DOS.  Finally we install our own Int 21H handler
; so we can service DOS calls from the protected mode application.

        public  initdosx
initdosx proc   near

        mov     ax,1687h                ; get address of DPMI
        int     2fh                     ;   mode switch entry point
        or      ax,ax                   ; bail out if no DPMI
        jnz     init9
        mov     word ptr modesw,di      ; save far pointer to
        mov     word ptr modesw+2,es    ;   DPMI entry point

        mov     bx,si                   ; allocate DPMI private data
        mov     ah,48h                  ; area below 1 MB boundary
        int     21h
        jc      init9                   ; jump, allocation failed

        mov     es,ax                   ; pass segment of data area
        mov     ax,0                    ; bit 0=0 indicates 16-bit app
        call    modesw                  ; switch to protected mode

        mov     ax,0202h                ; get address of previous
        mov     bl,0dh                  ; owner of GP fault vector
        int     31h
        mov     word ptr int0dv,dx      ; save as far pointer
        mov     word ptr int0dv+2,cx

        mov     ax,0203h                ; install our GP fault handler
        mov     bl,0dh
        mov     cx,cs                   ; CX:DX = handler address
        mov     dx,offset _TEXT:gpfier
        int     31h
        jc      init9                   ; jump, couldn't install

        mov     ax,0100h                ; allocate 64 KB buffer in
        mov     bx,1000h                ; conventional memory for
        int     31h                     ; communication with DOS
        jc      init9                   ; jump, allocation failed
        mov     realseg,ax              ; save segment of block
        mov     realsel,dx              ; save selector for block

        mov     ax,0204h                ; get address of previous
```

function calls must be trapped and serviced entirely within the DOS extender, and this can be a fair amount of work in itself (particularly if the DOS extender supports virtual memory).

One more function that bears mentioning is INT 21h, function 4Ch, which an application calls to terminate itself. When the DOS extender sees this function request, it must deallocate its (and the application's) extended memory, release the interrupt subsystem, and remove any other little tendrils it may have inserted elsewhere. This is tricky business, because the DOS extender—which has been playing the role of a little protected-mode operating system that uses DOS as a file system slave—must quietly and gracefully put everything back *exactly* as it was before the DOS extender was loaded, leaving the system completely stable. Finally, the DOS extender must switch the CPU into real mode for the last time and itself call INT 21h, function 4Ch, so that DOS knows to free all conventional memory, file handles, and other resources that were assigned to the DOS extender.

A SIMPLE DPMI-BASED DOS EXTENDER

I always find source code much more enlightening than windy explanations, so I've illustrated the foregoing discussion of DOS extenders with TINYDOSX.ASM (Figure 1), a skeleton DOS extender that you can use in your own programs. TINYDOSX relies only on the existence of a DPMI 0.9 host, such as the one found in *Windows* 3.0; it can be linked into any small-model C program and will cause that program to execute in protected mode—provided you don't call any run-time library functions that include self-modifying code, use segment registers for scratch storage, perform segment register arithmetic, or in general execute any instruction that will result in a general protection fault. Although *Windows* 3.0 includes a DOS extender of its own, TINYDOSX doesn't use it and will run just as well in other DPMI, Version 0.9, environments (at least theoretically; no other such environments exist for testing at this time).

Memory management function calls must be trapped and serviced entirely within the DOS extender, which can be a fair amount of work.

The initialization portion of TINYDOSX, embodied in the routine INITDOSX, is straightforward. To keep things simple, we allow the C application to get control first in real mode, and require it to explicitly call the DOS extender, rather than the other way around. INITDOSX first calls INT 2Fh, function 1687h to find out whether a DPMI host is present, and if so, the address of the mode switch entry point. If a DPMI host is not found, INITDOSX bails out with an error message; otherwise, it proceeds to allocate the private data area required by the DPMI host and then requests the switch into protected mode.

Once it's running in protected-mode, INITDOSX installs protected mode handlers for MS-DOS INT 21h and for general protection faults (so that *Windows* won't

TINYDOSX.ASM 3 of 4

```
        mov     bl,21h                  ; owner of Int 21H vector
        int     31h
        mov     word ptr int21v,dx      ; save as far pointer
        mov     word ptr int21v+2,cx

        mov     ax,0205h                ; install our Int 31H handler
        mov     bl,21h
        mov     cx,cs                   ; CX:DX = handler address
        mov     dx,offset _TEXT:doscall
        int     31h

        xor     ax,ax                   ; return in protected mode
        ret                             ; AX = 0 to signal success

init9:  mov     ax,-1                   ; return with AX <> 0 to
        ret                             ; signal initialization failure

initdosx endp
;
; Interrupt service routine for GP faults. Entered by a far call
; from DPMI host with CS:IP, flags, CPU error code on stack.
; We force transfer to our error message routine by changing
; return address in the stack frame.
;
gpfisr  proc    far

        push    bp                      ; point CS:IP in stack frame to
        mov     bp,sp                   ; GP fault error message routine
        mov     word ptr [bp+0],offset _TEXT:gpferr
        pop     bp
        ret

gpfisr  endp
;
; This routine gains control after the GPFISR returns to the DPMI host.
; It simply displays an error message and terminates cleanly, subverting
; Win 3's "Application has violated system integrity" dialog box.
;
gpferr  proc    near

        mov     dx,offset DGROUP:gpfmsg ; display GP fault message
        mov     cx,gpfmsg_len           ; on standard output
        mov     bx,stdout
        mov     ah,40h
        int     21h
        mov     ax,4c01h                ; and terminate with
        int     21h                     ; nonzero return code

gpferr  endp
;
; The DOSCALL routine is the runtime portion of the Tiny DOS Extender.
; It traps Int 21H requests in protected mode and performs any necessary
; mode switching, data movement, and address translation on a
; function-by-function basis.  Anything DOSCALL doesn't want to handle,
; it either fails by setting the Carry flag and returning, or
; it aborts the current program.  In particular, all FCB-related
; functions are aborted.  When a termination function is detected,
; the interrupt handlers are unhooked and the function call is
; passed down to the DPMI host so that all other protected mode
; resources will be deallocated.
;
```

```
doscall proc    far

        push    bx                      ; save register bx
        mov     bl,ah                   ; function number * 2
        xor     bh,bh
        cmp     bx,6fh                  ; function no. too big?
        ja      abort                   ; yes, bail out
        add     bx,bx                   ; no, branch through table
        jmp     [dispatch+bx]           ; to function handler

abort:                                  ; unsupported DOS function
        mov     dx,offset DGROUP:abmsg  ; display error message
        mov     cx,abmsg_len
        mov     bx,stdout
        mov     ah,40h
        int     21h
        mov     ax,4c81h                ; and exit to DOS
        int     21h

error:                                  ; unsupported DOS function
        push    bp                      ; set Carry flag in stack
        mov     bp,sp                   ;   frame to indicate
        or      word ptr [bp+6],1       ;   function failed
        pop     bp                      ; load AX = error code for
        mov     ax,1                    ;   "invalid function number"
        iret                            ; return to application

                                        ; common handling for entirely
                                        ;   register-based functions
fxn01h:                                 ; function 01H: char input+echo
fxn02h:                                 ; function 02H: char output
fxn03h:                                 ; function 03H: aux input
fxn04h:                                 ; function 04H: aux output
fxn05h:                                 ; function 05H: printer output
fxn06h:                                 ; function 06H: raw console I/O
fxn07h:                                 ; function 07H: raw input no echo
fxn08h:                                 ; function 08H: char input no echo
fxn0bh:                                 ; function 0BH: input status
fxn0dh:                                 ; function 0DH: disk reset
fxn0eh:                                 ; function 0EH: select disk
fxn19h:                                 ; function 19H: get current drive
fxn1bh:                                 ; function 1BH: get cur. drive data
fxn1ch:                                 ; function 1CH: get drive data
fxn2ah:                                 ; function 2AH: get date
fxn2bh:                                 ; function 2BH: set date
fxn2ch:                                 ; function 2CH: get time
fxn2dh:                                 ; function 2DH: set time
fxn2eh:                                 ; function 2EH: set verify flag
fxn30h:                                 ; function 30H: get DOS version
fxn33h:                                 ; function 33H: get/set break flag
fxn36h:                                 ; function 36H: get drive info
fxn3eh:                                 ; function 3EH: close file
fxn42h:                                 ; function 42H: seek
fxn45h:                                 ; function 45H: dup handle
fxn46h:                                 ; function 46H: redirect handle
fxn54h:                                 ; function 54H: get verify flag
fxn57h:                                 ; function 57H: get/set filedate
fxn5ch:                                 ; function 5CH: lock/unlock
fxn68h:                                 ; function 68H: commit file
        pop     bx                      ; restore BX
        call    saveregs                ; unload general registers
```

AW... WHAT THE HECK!

Let's see the other guys beat this price!

PC MAGAZINE EDITORS CHOICE December 11, 1990

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TINYDOSX.ASM 4 of 4

```
        call    realdos                 ; transfer to DOS
        call    loadregs                ; load general registers & flags
        iret                            ; return to application

                                        ; common handling for functions
                                        ;   passing ASCIIZ addr in DS:DX
fxn39h:                                 ; function 39H: create directory
fxn3ah:                                 ; function 3AH: delete directory
fxn3bh:                                 ; function 3BH: select directory
fxn3ch:                                 ; function 3CH: create file
fxn3dh:                                 ; function 3DH: open
fxn41h:                                 ; function 41H: delete file
fxn43h:                                 ; function 43H: get/set attributes
fxn5ah:                                 ; function 5AH: create temp file
fxn5bh:                                 ; function 5BH: create unique file
        pop     bx                      ; restore BX
        call    saveregs                ; unload general registers
        mov     es,realsel              ; ES:DI = virtual address of
        xor     di,di                   ;         real mode buffer
        mov     si,dx                   ; DS:SI = virtual address of
        cld                             ;         protected mode buffer
@@1:    lodsb                           ; copy ASCIIZ string to
        stosb                           ; real mode buffer
        or      al,al                   ; reached null yet?
        jnz     @@1                     ; no, copy another character
        mov     ax,realseg              ; set address of real mode buffer
        mov     regDS,ax                ; into register data structure
        mov     regDX,0
        call    realdos                 ; transfer to MS-DOS
        call    loadregs                ; load general registers & flags
        mov     dx,protDX               ; restore protected mode DX, ES
        mov     es,protES
        iret                            ; return to application

fxn3fh:                                 ; function 3FH: read file
        pop     bx                      ; restore BX
        call    saveregs                ; unload general registers
        mov     ax,realseg              ; set address of real mode buffer
        mov     regDS,ax                ; into register data structure
        mov     regDX,0
        call    realdos                 ; transfer to MS-DOS
        mov     cx,regCX                ; CX = actual length of data
        push    ds                      ; ES:DI = virtual address of
        pop     es                      ;         protected mode buffer
        mov     di,protDX
        mov     ds,realsel              ; DS:SI = virtual address of
        xor     si,si                   ;         real mode buffer
        cld                             ; copy data from real mode
        rep movsb                       ; buffer to protected mode buffer
        push    es                      ; restore DS = our DGROUP
        pop     ds
        call    loadregs                ; load general registers
        mov     dx,protDX               ; restore protected mode DX, ES
        mov     es,protES
        iret                            ; return to application

fxn40h:                                 ; function 40H: write file
        pop     bx                      ; restore BX
        call    saveregs                ; unload general registers
        mov     es,realsel              ; ES:DI = virtual address of
        xor     di,di                   ;         real mode buffer
        mov     si,dx                   ; DS:SI = virtual address of
        cld                             ;         protected mode buffer
        rep movsb                       ; copy data to real mode buffer
        mov     ax,realseg              ; set address of real mode buffer
        mov     regDS,ax                ; into register data structure
        mov     regDX,0
        call    realdos                 ; transfer to MS-DOS
        call    loadregs                ; load general registers & flags
        mov     dx,protDX               ; restore protected mode DX, ES
        mov     es,protES
        iret                            ; return to application

fxn47h:                                 ; function 47H: get directory
        pop     bx                      ; restore BX
        call    saveregs                ; unload general registers
        mov     ax,realseg              ; set address of real mode buffer
        mov     regDS,ax                ; into register data structure
        mov     regSI,0
        call    realdos                 ; transfer to MS-DOS
        push    ds                      ; ES:DI = virtual address of
        pop     es                      ;         protected mode buffer
        mov     di,protSI
        mov     ds,realsel              ; DS:SI = virtual address of
        xor     si,si                   ;         real mode buffer
        cld
@@2:    lodsb                           ; copy ASCIIZ string from real
        stosb                           ; mode buffer to prot mode buffer
        or      al,al                   ; found null character yet?
        jnz     @@2                     ; no, copy another character
        push    es                      ; restore DS = our DGROUP
        pop     ds
        call    loadregs                ; load general registers
        mov     si,protSI               ; restore protected mode SI, ES
        mov     es,protES
        iret                            ; return to application

fxn4ch:                                 ; function 4CH: terminate
```

```
fxn4ch: pop     bx                      ; function 4CH: terminate
        push    ax                      ; save return code
        mov     ax,0203h                ; restore old GP fault handler
        mov     bl,0dh
        mov     cx,word ptr int0dv+2
        mov     dx,word ptr int0dv
        int     31h
        mov     ax,0205h                ; restore old Int 21H handler
        mov     bl,21h
        mov     cx,word ptr int21v+2
        mov     dx,word ptr int21v
        int     31h
        mov     ax,0101h                ; release real mode buffer
        mov     dx,realsel
        int     31h
        pop     ax                      ; chain to DPMI Int 21H handler
        int     21h                     ; for cleanup and termination

chain:                                  ; general fallthrough point
                                        ; (useful during debugging)
        pop     bx                      ; restore register BX
        jmp     int21v                  ; chain to prev Int 21H owner

doscall endp
;
; Save general registers into real mode data structure for a call to
; real mode routine via DPMI translation services.  Note that segment
; registers are NOT unloaded into structure because they are not valid
; for real mode anyway.
;
saveregs proc   near

        mov     regAX,ax                ; save general registers
        mov     regBX,bx
        mov     regCX,cx
        mov     regDX,dx
        mov     regSI,si
        mov     regDI,di
        mov     regBP,bp
        mov     protDX,dx               ; extra copies for non-
        mov     protSI,si               ; register-based functions
        mov     protES,es
        ret

saveregs endp
;
; Load general registers from real mode data structure.  Note that
; segment registers are NOT loaded because their real mode values
; would cause a GP fault in protected mode.
;
loadregs proc   near

        mov     bp,sp                   ; update CPU flags in
        push    cpuFLAGS                ; stack frame to return
        pop     [bp+6]                  ; DOS function status
        mov     ax,regAX                ; load general registers
        mov     bx,regBX
        mov     cx,regCX
        mov     dx,regDX
        mov     si,regSI
        mov     di,regDI
        mov     bp,regBP
        ret

loadregs endp
;
; Call the DPMI translation function 0300H to simulate a real mode
; software interrupt 21H, transferring control to MS-DOS, passing
; the values stored into the real mode register structure 'regs'.
;
realdos proc    near

        push    es
        mov     ax,0300h                ; DPMI Function 0300H
        mov     bl,21h                  ; software interrupt 21H
        mov     bh,0                    ; flags (bit 0 must be 0)
        mov     cx,0                    ; no. of stack words to copy
        push    ds                      ; ES:DI = address of real
        pop     es                      ; mode register structure
        mov     di,offset DGROUP:regs
        int     31h                     ; to DOS via DPMI host
        pop     es
        ret

realdos endp

_TEXT   ends

        end
```

blow our little programming blunders out of the water with its totally uninformative "Application has violated system integrity" dialog box). INITDOSX also allocates a 64K area of conventional memory that the INT 21h handler can later use to pass data back and forth to MS-DOS. Finally, INITDOSX returns control to the C application, which continues its execution in protected mode.

When the C application requests an MS-DOS service, the protected-mode INT 21h handler, named DOSCALL, receives control. DOSCALL saves the flags and registers, then branches through the table DISPATCH to the appropriate subroutine. As you'll notice, I've stubbed out most of the less-common DOS functions to either return an error or abort the application. The functions that TINYDOSX supports, however, are relayed to DOS using the DPMI translation function "Simulate Real Mode Interrupt." Use of this translation function, rather than the speedier DPMI "raw mode switch" function, eliminates all sorts of messy problems that are best left to the imagination and experiments of adventurous readers. Naturally, DOSCALL monitors for the fateful INT 21h, function 4Ch, and cleans up after itself accordingly.

Assuming DPMI 0.9 as our platform and linking TINYDOSX directly into the protected-mode application allows us to take some shortcuts that would never suffice in a commercial-grade DOS extender. First, we don't have to build our own loader for the protected-mode application; since TINYDOSX is linked into the application, DOS loads TINYDOSX and the application as a single unit. Second, we don't have to allocate any memory

TINYDOSX.C

```
/*
    TESTDOSX.C --- illustrates use of the DPMI-based
    DOS Extender TINYDOSX to display a message in protected mode

    Copyright (C) 1990 Ziff Davis Communications
    PC Magazine * Ray Duncan

    Build with Microsoft C 6.0 SMALL MODEL as follows:

          MASM TINYDOSX;
          CL TESTDOSX.C TINYDOSX

    Execute under Windows 3.0 in the DOS Box only!
*/

#include <stdio.h>

unsigned extern pascal InitDosX(void);

main()
{
    unsigned saveCS, saveDS;

    _asm mov saveCS,cs          ; store real mode CS
    _asm mov saveDS,ds          ; and DS for display

    printf("\nHello, real mode world! \tCS=%04xh DS=%04xh",
        saveCS, saveDS);

    if(InitDosX())              // attempt mode switch
    {
        puts("\nDPMI initialization failed.");
        exit(1);
    }

    _asm mov saveCS,cs          ; store protected mode CS
    _asm mov saveDS,ds          ; and DS for display

    printf("\nHello, protected mode world! \tCS=%04xh DS=%04xh\n
        saveCS, saveDS);

    _asm mov ah,4ch             ; exit directly to DOS to avoid
    _asm int 21h                ; GP fault in RTL cleanup code
}
```

Figure 2: This is the source code for a simple protected-mode C application that can be linked with TINYDOSX.ASM, listed in Figure 1.

for the application or build any descriptors; we get these services "free" when DPMI creates code and data selectors during the initial switch to protected mode. Third, we need to support only those DOS services in our DOS extender that we know our application is actually going to use; we don't have the obligation to translate every known (and unknown) DOS function for protected mode the way a "real" DOS extender does.

Suppose we wanted to turn TINYDOSX into a not-so-tiny, more robust DOS extender—where would we start? We'd have to enlarge the support for INT 21h functions to include (at minimum) all the documented MS-DOS services. We'd need to support the immense battery of ROM BIOS services (most of which, luckily, are register-based anyway) and probably, in addition, the Microsoft Mouse INT 33h and the NETBIOS interfaces. We'd want to add more sophisticated facilities for installation of interrupt handlers by the application. And last but not least, we'd be obligated to support most of the different C memory models, a somewhat thorny chore. My first impression of the way to do this would be to incorporate a loader for "segmented .EXE" (also called "new .EXE") files into our DOS extender, build the application with the Microsoft Segmented Linker, and bind our DOS extender into the .EXE file as the "real-mode stub."

TRYING OUT TINYDOSX

TESTDOSX.C, a simple protected-mode C application that can be linked with TINYDOSX.ASM, is shown in Figure 2. To create the executable version of TESTDOSX, enter the following commands:

```
MASM /Mx TINYDOSX;
CL TESTDOSX.C TINYDOSX
```

Be sure that you are using Microsoft 6.0 and compiling for the small model. The resulting application, TESTDOSX.EXE, must be run in one of *Windows* 3.0's DOS boxes so that it has access to DPMI services.

THE IN-BOX

Please send your questions, comments, and suggestions to me at any of the following e-mail addresses:
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by
William S. Hall

Windows

MOVING DATA TO CARDFILE

I have a small 200-record database file (consisting of names, addresses, and phone numbers) that I would like to import into a *Windows* 3.0 Cardfile. I can format and edit a dump of the file. But without knowing the internal organization of data in Cardfile, I have to import the database to a text file and then copy-and-paste each new entry one by one through the Clipboard. There has to be an easier way. Any ideas?

Steven Milbourne
Rosemont, Pennsylvania

- MOVING DATA TO CARDFILE: The macro recorder is an effective tool for transferring database records into Cardfile.
- LIMITED MEMORY IN STANDARD MODE: A few words about the optimum configuration for your CONFIG.SYS.

PC MAGAZINE I have two suggestions that will help you out:

The first is to write a program that converts your database file to a format compatible with Cardfile. Of course, this is practical only if you like to dabble in programming. You can get a description of Cardfile's data format from Microsoft Product Support (206-454-2030). The task is not difficult, but it will certainly require a few hours' work with BASIC, C, PASCAL, or your favorite language.

An alternative approach is to automate the cut-and-paste operation, using the *Windows* Recorder. About half the problem lies in setting up a starting configuration; the remaining difficulties concern recording the macro correctly. Despite its limitations, this is exactly the kind of task the Recorder can perform quite well. I'll offer an example, that you can adjust according to your needs.

First, you must dump the database to a text file. Its exact format depends partly on your data and partly on the contents of a Cardfile card. Recall that each record (card) in Cardfile has two fields: a one-line index and then several lines of text. In an address file, you use the index field to hold the person's name. The rest of the card contains the address and telephone number. Each card is 40 characters wide, and the main part has a maximum of 11 lines. It's very important to keep these limitations in mind when you format the dump.

Since we're going to use the recorder to move a record from the database dump to a card in Cardfile, each record must be formatted the same way. For example, if your database has some records with three-line addresses and some with four, then dump them all with four lines. Pad the record with extra lines if necessary. You should also separate the name from the address/telephone information by a single line. Each subsequent record should be spaced one line away from the next as well. The exact form you use can differ from my example, just make it consistent across records.

If you use Notepad for the transfer, keep in mind that it is limited in the size of the file it can read (about 50K at most). You may need to use *Windows* Write if your database is large. If you do use *Windows* Write, you don't have to separate the name from the address information by a separate line. When Write selects an entire line, it actually includes the end-of-line character, whereas Notepad does not. With either program, you should separate records by an empty line.

Figure 1 shows a simple address file (left) with three records. This is how they might appear after you have dumped your database into a text file and loaded it into Notepad. On the right is a card file into which each record has been moved with the aid of the Recorder. There's a blank card also; it's the first one displayed when you bring up Cardfile. You can remove it after you've transferred the records. Just bring it into focus by clicking on it with the mouse and then execute the Delete command under the Card menu.

Figure 2 shows the keystrokes you must record to move one record. As you can see, the macro copies the name into a card's index field, creating a new card in the process. Then it copies the address and telephone information into the card. Finally, it positions the cursor on the next name in the Notepad file. It's a good idea to run the macro for each record. To make things easier, you will want to assign it a shortcut key. To ensure that there's no need for mouse positioning, the macro uses only keystroke commands. Macros that depend on mouse movements can fail if you change the appearance of the screen.

Here are the steps you should use to record the macro:

- Close or minimize all applications except the Program Manager. Eventually we'll tile the two applications side by side. Having any other programs open will interfere with the tiling.
- Minimize the Program Manager.
- Bring up the Task Manager (Ctrl-Esc) and click on Tile. Now you should have Notepad and Cardfile side by side. It doesn't matter which is on the left and which is on the right.
- Click on Notepad to make it the active window. Make sure the text cursor is at the start of the file.
- Restore the Recorder (double-click on the icon) and select New under the File menu and Record under Macro.
- Give the macro a name (I used NEWCARD) and assign a shortcut key. Select the key from the list presented (I chose Ctrl-Backspace) or type your own. Accept the rest of the defaults and press the Start button.

Enter the keystrokes shown in Figure 2. Type Ctrl-Break to end and save the macro.

Verify that you are positioned at the beginning of the next record in the Notepad file and then type the macro shortcut key. You should see the next record moved correctly to Cardfile. Continue to use the shortcut key to transfer each subsequent record into Cardfile.

If you make a mistake in the recording session, type Ctrl-Break to end it and discard the macro. Clear the Cardfile with a New command, put the focus back on Notepad, and reposition its cursor at the top of the file. Create a new macro with Recorder and try again.

If you don't want to type the shortcut key over and over, you can run the macro in a continuous loop. Just select Continuous Loop from the Properties dialog box under Recorder's Macro menu in Recorder. I do not, however, recommend this procedure. The operation moves quite fast, and if things go wrong, you may not recognize it until it's too late. At any rate, you'll have to stop the macro with Ctrl-Break when you've seen the last record transferred.

Unfortunately, the Recorder is ignorant of the contents of Notepad or Cardfile files. It cannot detect the end of file in the source or whether the destination is full. The documentation mentions no absolute size limitation on Cardfile. The number of cards you can dump depends on the amount of memory in the computer and the amount of information on each card.

CREATING CARDS

Keystroke	Comments
Shift–Down Arrow	Select first line of record, including the new line.
Alt-E-C	Copy the selected line to Clipboard.
Alt-Tab	Switch to the Cardfile program.
Alt-C-A	Create the add-new-card dialog box.
Shift-Insert	Copy data from Clipboard into new card dialog box.
Enter	Create new card with data just copied as index line.
Alt-Tab	Switch to Notepad.
Down Arrow	Clear previous selection and move to next line Shift.
Down Arrow	Select address line 1.
Shift–Down Arrow	Select address line 2.
Shift–Down Arrow	Select telephone number.
Alt-E-C	Copy selected data to Clipboard.
Alt-Tab	Switch to Cardfile.
Shift-Insert	Copy data from Clipboard to new card data area.
Alt-Tab	Switch to Notepad.
Down Arrow	Clear selection and move to next record.
Ctrl-Break	End recording.

Figure 2: These are the commands required to build a macro that transfers text-file data into a Cardfile card.

LIMITED MEMORY IN STANDARD MODE

With a 286 machine and 2MB of extended memory, what is the optimum setup in the CONFIG.SYS file for real and standard modes of *Windows* 3.0?

Henry C. Yau
Winnipeg, Manitoba
Canada

Before answering this question, I'll assume that all *Windows*-supplied DOS device drivers are in C:\WINDOWS. (Note that HIMEM.SYS is the exception. It's placed in the root directory and used by other programs such as the *Microsoft Programmer's Workbench*, Version 6.0). Given this criterion, here's my suggestion:

```
device=c:\HIMEM.SYS
device=C:\WINDOWS\SMARTDRV.SYS
 1024 256
files=30
buffers=10
```

If you have an EGA display, add the line:

```
device=c:\windows\ega.sys
```

The command in the first line tells your computer to run HIMEM.SYS. You need HIMEM before you can run *Windows* in standard or enhanced mode. In real mode, it's not required, but it gives you about 50K of extra conventional memory, since some of *Windows* can use High Memory (the first 64K segment of memory above 1MB). Moreover, you'll need HIMEM for SmartDrive.

The second line calls SmartDrive. SmartDrive is a disk-caching program that can improve disk performance—whether you're running in *Windows* or just DOS. The first parameter, 1024, assigns 1MB of memory to SmartDrive when you're not in *Windows*. The second parameter, 256, is the minimum size in kilobytes to which you can reduce SmartDrive when *Windows* is running. The reduction takes place only if *Windows* needs additional extended memory. *Windows* understands SmartDrive and can recover memory allocated to the

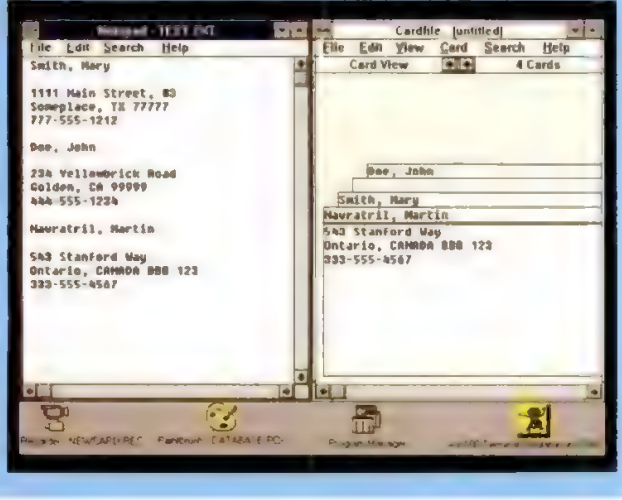

Figure 1: On the left is a simple Notepad address file with three records. The figure on the right shows the same addresses after being transferred to Cardfile. They were transferred using a *Windows* Recorder macro. Figure 2 lists the steps needed to create this macro.

cache. You can control the amount of memory *Windows* leaves to SmartDrive by adjusting the second parameter. The lower limit is 256K. If you don't want *Windows* to take any memory, you can set the minimum to 1,024—the same amount assigned to the first parameter.

As to the last two lines, 30 is Microsoft's recommended setting for files. And if you have SmartDrive running, Microsoft suggests only 10 buffers.

This configuration will leave you with all your conventional memory (minus the overhead of DOS and the device drivers) and 1MB of extended memory. Extended memory will expand still further with the 768K (1,024 minus 256) that *Windows* can recover from SmartDrive.

You can also add the line

```
TEMP=[drive]:\tempdir
```

to your AUTOEXEC.BAT. TEMPDIR is a directory that should be located on a hard disk with a megabyte or more of free space. Many *Windows* applications store temporary files while running. If you've defined the environment variable, TEMP, the applications will use the specified directory for those temporary files. In specifying a temporary directory, you can make sure TEMP points to a disk with enough space. If it points to a crowded disk, then you may be unable to create these temporary files.

The advantage of specifying a temporary directory is that you can make sure TEMP points to a disk with enough space.

Normally, I would recommend that TEMPDIR be located on a RAM disk of at least 1MB in size. But Mr. Yau specifies only 2MB of extended memory, so a RAM disk is not practical. (If you do install a RAM drive, make sure that it's RAMDRIVE.SYS from the *Windows* disk.)

The configuration I have just described will deliver good performance in standard mode. Real mode won't be affected. Real mode can use expanded and conventional memory, but not the extra extended memory (except with the HIMEM segment or indirectly through SmartDrive or as a RAM disk). But since Mr. Yau doesn't mention expanded memory, I'm assuming only conventional memory is available. Consequently, if he tries to run several programs simultaneously, there may be quite a bit of disk activity as segments are discarded and reloaded.

OPENING WINDOWS

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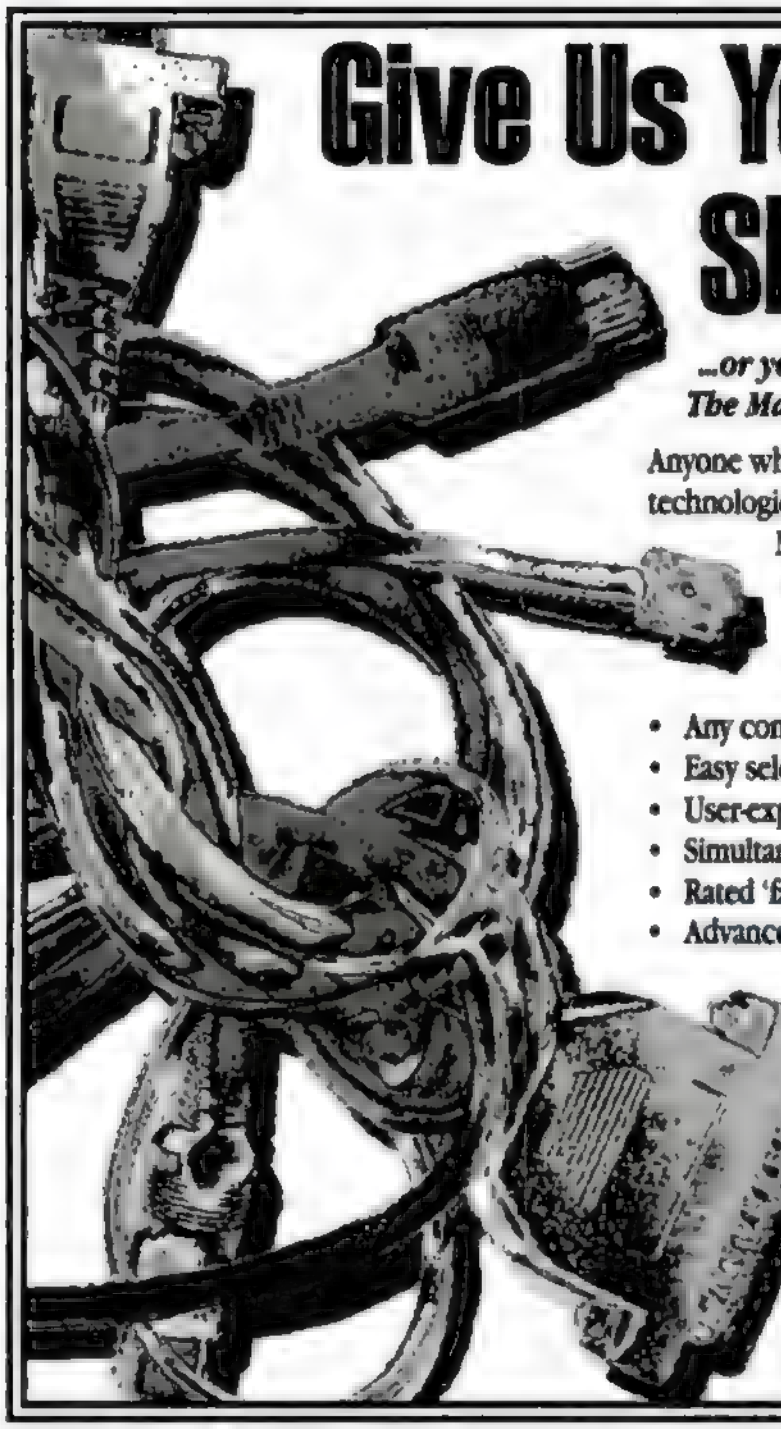

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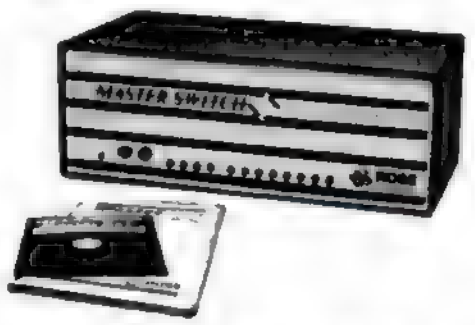

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CIRCLE 290 ON READER SERVICE CARD

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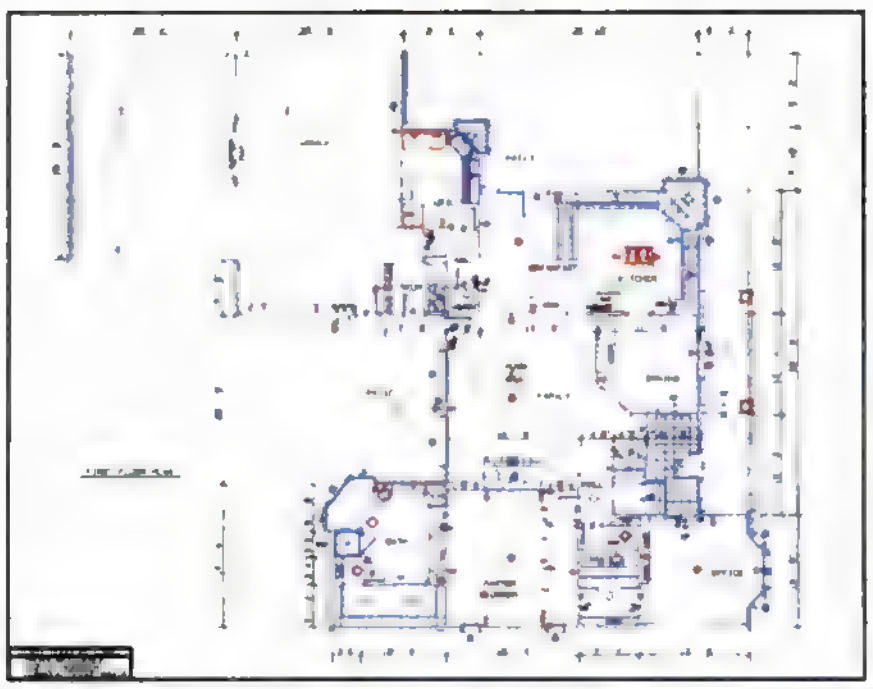

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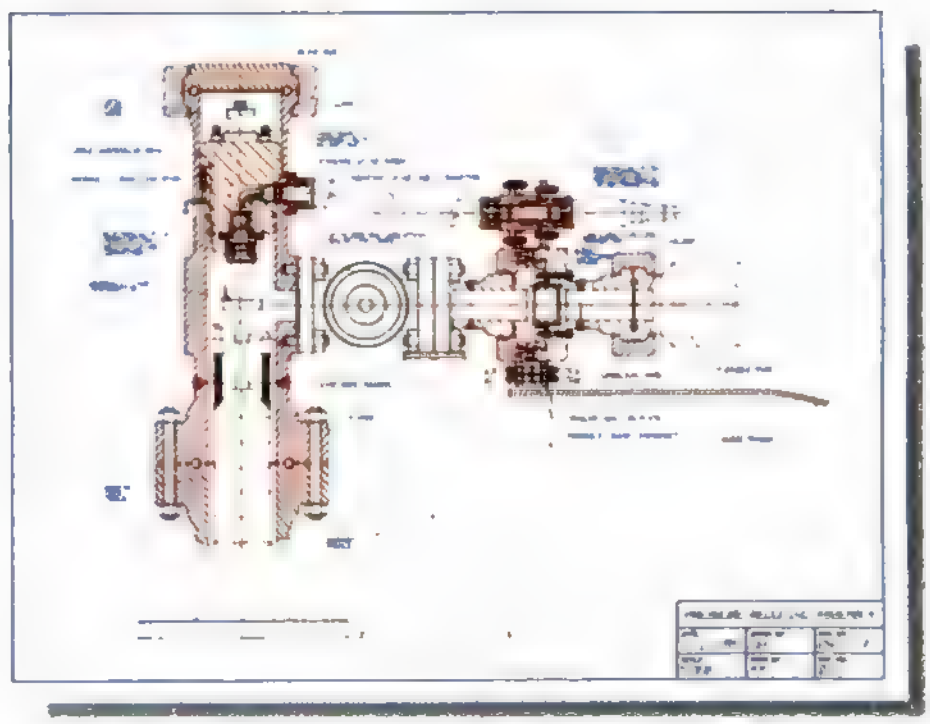

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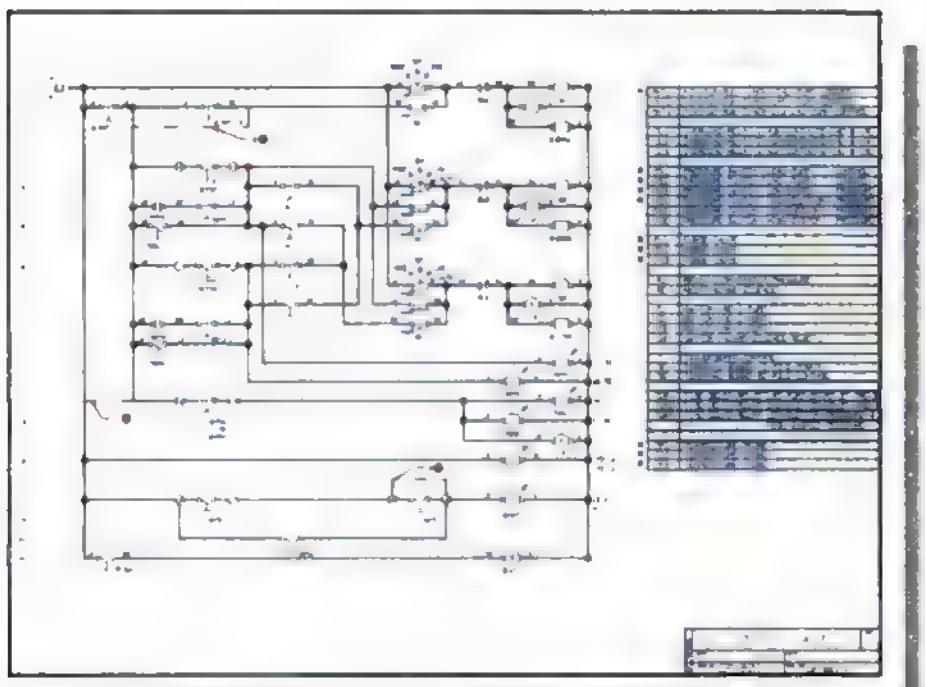

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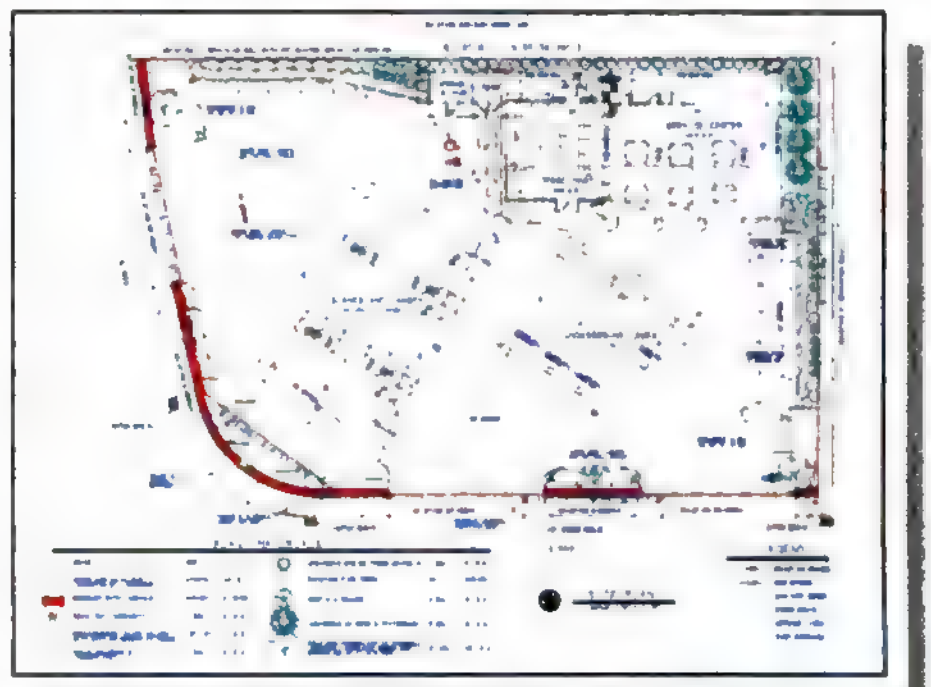

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CIRCLE 506 ON READER SERVICE CARD

by
Sal Ricciardi

Databases

POP-UP CALENDAR

I wanted to offer users an easy method for selecting dates from a calendar rather than typing them in directly. Although *FoxPro* lets the programmer easily incorporate its Calendar/Diary desktop accessory in an application, it's almost impossible to control this feature through the programming language.

After experimenting a bit with *FoxPro*'s DEFINE WINDOW command and the INKEY function, I found a way to use the built-in Calendar/Diary to let the user pick a date. The result is a UDF (user-defined function) called POPDATE (shown in Figure 1). The advantage of this function is that only a few lines of code are required to produce a user-friendly calendar. POPDATE will work only with *FoxPro*, Version 1.02, however.

To use POPDATE in your program, pass POPDATE a row-and-column location where you want it to display the calendar, and a default date (the date is optional). If you specify the default date, it will appear selected in the calendar. If no date is passed, the date defaults to the current _DIARYDATE (the _DIARYDATE is the date maintained by the _DIARYDATE system variable, and it controls which date will be shown on the calendar).

■ POP-UP CALENDAR: A hotkey can pop up a calendar within your application using this *FoxPro* UDF.

The program uses the _DIARYDATE system variable to adjust the date on the calendar, based upon the value returned by INKEY(). The *FoxPro* GOMONTH function makes it easy to move the calendar forward or backward a month or a year.

POPDATE's main limitation is that it does not support the mouse, although it might be possible to do this by using the MROW() and MCOL() functions.

Andrew Coupe
Silver Spring, Maryland

The ability to pop up an easy-to-use calendar for date selection is a welcome addition to any programming arsenal. Mr. Coupe's clever use of *FoxPro*'s built-in calendar accessory shows how easy it is to add this capability to your *FoxPro* applications.

Normally, the Calendar and Diary sections of the Calendar/Diary accessory are inseparable. That is, you cannot display one without the other. This remains true in POPDATE even though it may appear otherwise. The POPDATE function simply hides the Diary section by displaying the Calendar window inside a smaller window sized so that only the Calendar section can be seen. Then it prevents access to the Dia-

POPDATE.PRG — COMPLETE LISTING

```
*************************************************************************
*   Name: POPDATE.PRG
* Author: Andrew Coupe
*  Usage: <expD>=POPDATE(<row>,<col>,[<default>])
*  Notes: UDF to popup a date selection box in FoxPRO 1.02
*************************************************************************
FUNCTION POPDATE
PARAMETER row,col,default

thismsg = SET("MESSAGE",1)              && Record current message line
thisdate =_diarydate                    && Save original date
*
* --- If default date is passed, use it, else use _dairydate
*
DEFAULT = IIF( PARAMETERS()=3, default, _diarydate)
_diarydate = default

DEFINE WINDOW CAL FROM row,col TO row+16,col+22 ;
DOUBLE TITLE "[CALENDAR]"
*
* --- Need SET STATUS ON to see the following message
*
SET MESSAGE TO ;
"Change date with arrow keys. [T]oday, Month:[PgUp/PgDn] Year:[^PgUp/^PgDn]"

ACTIVATE WINDOW cal
ACTIVATE WINDOW calendar IN cal
MOVE WINDOW calendar TO -1,-1           && Center calendar in window

DO WHILE LASTKEY() # 27                 && While ESCAPE not HIT

   i=INKEY(0,"M")                       && Get keystroke
   DO CASE
    CASE i=13 .OR. i=27                 && Enter or Esc
      EXIT

    CASE i=84.OR. i=116                 && 'T' for Today
      _diarydate=DATE()

    CASE i =24                          && Down arrow
      _diarydate=_diarydate+7

    CASE i= 5                           && Up arrow

      _diarydate=_diarydate-7

    CASE i=19                           && Left arrow
      _diarydate=_diarydate-1

    CASE i=4                            && Right arrow
      _diarydate=_diarydate+1

    CASE i=3                            && Page down
      _diarydate=gomonth(_diarydate,1)

    CASE i=18                           && Page up
      _diarydate=gomonth(_diarydate,-1)

    CASE I= 30                          && ^Page down
      _diarydate=gomonth(_diarydate,12)

    CASE I= 31                          && ^Page Up
      _diarydate=gomonth(_diarydate,-12)
   ENDCASE
ENDDO

SET MESSAGE TO (thismsg)                && Restore message
RELEASE WINDOWS cal                     && Release CAL windows
*
* --- Return default date if ESC was pressed
*
newdate = ;
IIF( LASTKEY()=27, default, _diarydate)

_diarydate = thisdate                   && Set system variable back

RETURN newdate                          && Return the selected date
```

Figure 1: This *FoxPro* user-defined function can be used to pop up a calendar for selecting a date.

CALDEMO.PRG — **COMPLETE LISTING**

```
*************************************************************
* CALDEMO.PRG
* Demonstrate use of PopDate
*************************************************************
SET ECHO OFF
SET TALK OFF
SET SYSMENU OFF

DO BackDrop                          && Background for demo purposes
DO Inquiry                           && Sample date field usage with
                                     && pop-up calendar
RELEASE ALL
CLEAR ALL
RETURN

*************************************************************
* PROCEDURE Inquiry
* Demonstrate use of PopDate, which is called from PopCal
*************************************************************
PROCEDURE Inquiry
DEFINE WINDOW Inquiry FROM  5,13 TO 15,67 ;
COLOR G+/B,N/W,BG+/B TITLE 'Inquiry'
ACTIVATE WINDOW Inquiry

@ 1, 8 SAY "Destination:"
@ 3, 2 SAY "Date of Departure:"
@ 4, 5 SAY "Date of Return:"
@ 6, 5 SAY "Number of days:"

STORE SPACE(25) TO m->dest
STORE DATE() TO m->depdate
STORE DATE()+1 TO m->retdate

ON KEY LABEL F2 DO PopCal            && F2 activates PopCal

DO WHILE .T.
   SET COLOR TO ,N/W
   @ 1,21 GET m->dest PICTURE "@M Hawaii, Florida, Italy" ;
   MESSAGE WinMsg("Enter destination, press spacebar to cycle choices")

   @ 3,21 GET m->depdate ;
   MESSAGE WinMsg("Enter Departure date, press F2 for calendar") ;
   VALID DateCheck(1, m->depdate, m->retdate) ;
   ERROR "Invalid departure date, please reenter"

   @ 4,21 GET m->retdate ;
   MESSAGE WinMsg("Enter Return date, press F2 for calendar") ;
   VALID DateCheck(2, m->depdate, m->retdate) ;
   ERROR "Invalid return date, please reenter"

   READ
   SET COLOR TO G+/B
   @ 6,21 SAY (m->retdate - m->depdate)+1 PICTURE [999]
   IF READKEY()==268 .OR. READKEY()==12   && Escape cancels
      EXIT
   ENDIF
ENDDO

ON KEY LABEL F2                      && Restore F2
RELEASE WINDOW Inquiry
RETURN

*************************************************************
* PROCEDURE PopCal
*
* Calls POPDATE.  Only allows pop-up if user is currently
* editing the departure date or return date fields
*************************************************************
PROCEDURE PopCal
PRIVATE var
var = VARREAD()                      && Find out what field we're in
DO CASE
 CASE var == "DEPDATE" .OR. ;
    var == "RETDATE"                 && If it is the departure date
                                     && or return date fields
    IF EMPTY(&var)                   && If it is empty don't set
       &var = POPDATE(2,51)          && the default in the calendar
    ELSE                             && otherwise pop-up the calendar
       &var = POPDATE(2,51,&var)     && with that date highlighted
    ENDIF
 OTHERWISE
ENDCASE
RETURN

*************************************************************
* FUNCTION WinMsg
*
* Display a centered message on the last line of the active
* window.  For use with the MESSAGE option on @...GET.
*************************************************************
FUNCTION WinMsg
PARAMETER TEXT
@ WROWS()-1, 0 SAY PADC(TEXT,WCOLS())
RETURN ""

*************************************************************
* FUNCTION DateCheck
* Simple validation for departure and return dates
*************************************************************
FUNCTION DateCheck
PARAMETERS dnum, ddate, rdate

DO CASE
 CASE dnum == 1                      && Validating the departure date
    *
    * --- Can't be before today or empty
    *
    IF ddate < DATE() .OR. EMPTY(ddate)
       RETURN .F.
    ENDIF
 CASE dnum == 2                      && Validating the return date
    *
    * --- Can't be before departure date or empty
    *
    IF rdate < ddate .OR. EMPTY(rdate)
       RETURN .F.
    ENDIF
 OTHERWISE
ENDCASE
RETURN .T.

*************************************************************
* PROCEDURE BackDrop
* Put some background on the screen for demo purposes
*************************************************************
PROCEDURE BackDrop
DEFINE WINDOW BackDrop FROM  3, 1 TO 17,79 ;
COLOR G+/B,N/W,BG+/B TITLE 'XYZ Travel Agency'
ACTIVATE WINDOW BackDrop
@ 1, 3 SAY "Prefix: Mr. and Mrs."
@ 2, 5 SAY "Last: Doe"
@ 3, 4 SAY "First: John"
@ 4, 3 SAY "Middle: J."
@ 5, 3 SAY "Suffix: Sr."
@ 7, 2 SAY "Address: 27 Pine Lane"
@ 8, 9 SAY ": Suite 21A"
@ 9, 9 SAY ":"
@10, 5 SAY "City: Anytown"
@11, 4 SAY "State: PA  Zip: 12345"
RETURN
```

Figure 2: This program illustrates how you can use the PopDate function to provide a pop-up date-selection calendar in your *FoxPro* programs.

ry section by intercepting all keystrokes via the INKEY() function.

Intercepting keystrokes in this manner lets POPDATE alter the _DIARYDATE system variable on the fly, depending on which key is hit. For example, if the Down Arrow key is hit, it adds 7 to _DIARYDATE, since each Down Arrow movement in the Calendar adds a week to the calendar date. Similarly, tapping the Left Arrow key results in a subtraction of 1 from _DIARYDATE, since such a movement in the Calendar pushes it back one day. And so on.

The _DIARYDATE system variable first became available in *FoxPro*, Version 1.02. It always contains the Calendar/Diary desktop accessory's current date. The POPDATE function works by changing this date. It relies on the fact that each change in _DIARYDATE's value is automatically and immediately reflected in the Calendar accessory.

The CALDEMO program shown in Figure 2 and Figure 3 illustrates how you might use the POPDATE function in your programs to provide an optional pop-up calendar during entry of a date field. It displays a data entry screen for entering a destination, departure and return date for a trip. During entry of either of the date fields, you can pop up a calendar to select a date by hitting F2.

To assign the pop-up routine to a hotkey (in this case, F2) CALDEMO uses *FoxPro*'s ON KEY LABEL as follows:

```
ON KEY LABEL F2 DO PopCal
```

Thereafter, when the hotkey is pressed, the attached routine is immediately executed in all places where ON KEY LABEL is recognized. You can have many ON KEY LABEL assignments active at one time. A second ON KEY LABEL F2 statement restores the F2 key to its default later on.

When the PopCal routine is called, it uses *FoxPro*'s VARREAD() function to

check which field was being edited when the F2 key was pressed. If the departure date or return date fields were being edited when F2 was pressed, VARREAD() will return either "DEPDATE" or "RETDATE" respectively. If either of these names are returned, PopCal calls POPDATE to pop up the calendar.

If PopCal discovers that neither of these two date fields was being edited, it returns immediately. This way PopCal prevents the calendar from being popped up during entry of the destination, for example. You can only pop up the calendar while in one of the date fields.

As Cope stated, the PopDate function does not support the mouse.

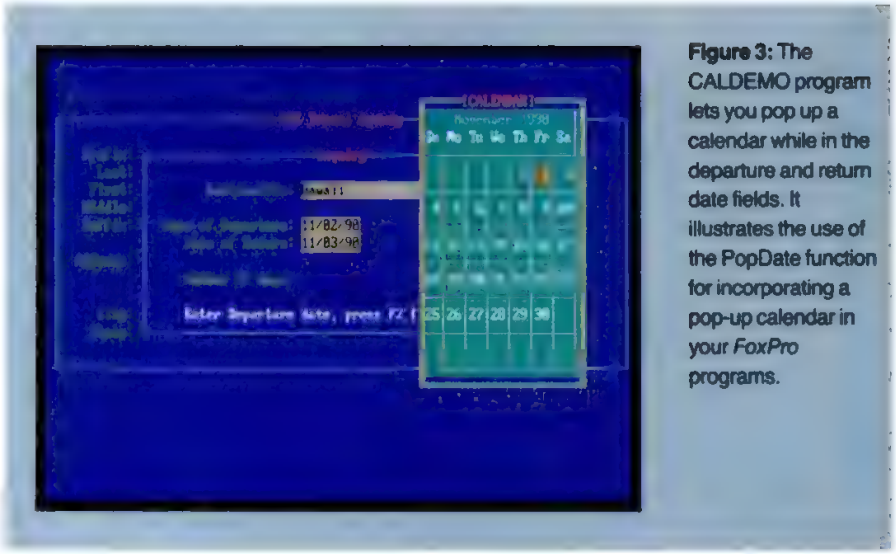

Figure 3: The CALDEMO program lets you pop up a calendar while in the departure and return date fields. It illustrates the use of the PopDate function for incorporating a pop-up calendar in your *FoxPro* programs.

CORRECTION

The following sentence appeared in the January 15, 1990, issue: "The Clipper ?? command (which is used to re-create the original file) evaluates a MAKECLIP expression and outputs a *dBASE* expression." It should have read: "The Clipper ?? command (which is used to re-create the original file) evaluates and outputs a *dBASE* expression."

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Sal Ricciardi is a New York-based consultant and a frequent contributor to PC Magazine.

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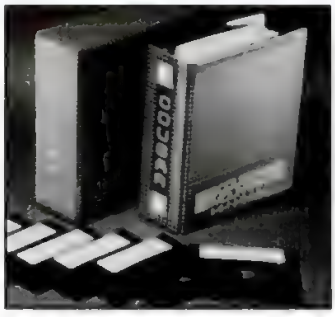

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CIRCLE 101 ON READER SERVICE CARD

by
Craig Stinson

Spreadsheets

DIALING NUMBERS FROM 1-2-3

I spend half my day working in *Lotus 1-2-3* and the other half on the phone, so I've developed a way to combine both activities. The macro listed in Figure 1 lets me dial numbers through my modem by issuing a command in *1-2-3*.

DIALNUM.WK1 presents a two-option menu named DIALMENU. One option prompts me for a number to dial. The other gets a phone number from the current cell. Either way, the number to be dialed is assigned to the cell named NUMBER.

Next, the macro uses the instruction

```
{System "MODE COM1:1200>NUL"}
```

to shell out to DOS and initialize the modem. It then returns to *1-2-3*, opens COM1, and dials the number stored in NUMBER. When the number has been dialed and I have picked up the receiver, I can press any key to hang up the modem.

Note that cells B14 and B16 contain string formulas. Those formulas are

```
B14:  +"{Indicate Dialing
       "&NUMBER&" * Press any key
       after dialing *}

B16:  +"{WRITELN "&QUOTES&"ATDT
       "&NUMBER&QUOTES&"}"
```

Be sure to enter these formulas, not the formula results shown in Figure 1.

The macro assumes you're using a 1,200-bps Hayes-compatible modem attached to COM1 and that your telephone line accepts tone dialing. If you have a 2,400-bps modem, you can change 1200 to 2400 in cell B13. If you're using COM2, change COM1 to COM2 in both B13 and B15. If you require pulse dialing, change ATDT to ATDP in B16.

The macro works in Release 2.2, Release 3.0, and Release 3.1. It doesn't work in Release 2.01—that version can't accept an argument with the {SYSTEM} command. Moreover, the argument for the {INDICATE} command in Release 2.01 can't exceed five characters.

■ DIALING NUMBERS FROM 1-2-3: Dial a telephone number without moving your fingers from the keyboard.

However, if you're using Release 2.01, you can still use a modified version of this macro to dial the telephone. You must perform two steps: delete the instructions in B13 and B14 and initialize your modem before you start *1-2-3*. To carry out the second step, just type

```
MODE COM1:1200
```

at the DOS prompt. You could also add the instruction to your AUTOEXEC.BAT file. When you use the macro, the number you're dialing won't be displayed in the MODE indicator, but everything else will operate normally.

R. A. McCormack
Thunder Bay, Ontario, Canada

PC MAGAZINE *1-2-3* users who object to tying up RAM with pop-up programs should appreciate Mr. McCormack's autodialer. The macro is clean and clever, and you can easily tailor it to your own needs. I have two customizing suggestions.

First, if you have a half-dozen numbers that you dial more often than any others, add them directly to DIALMENU. Figure 2 shows how DIALMENU might appear with two additional options: numbers for Bert and Ernie.

Because custom menus in *Lotus 1-2-3* are limited to eight items, this "speed-dial" modification will accept a maximum of six hard-wired numbers (unless, of course, you also remove Mr. McCormack's first two menu items). If each item in the menu starts with a different letter, you'll be able to dial anyone on the list by pressing the first letter of his or her name.

If you want to keep a more extensive phone list on your worksheet and you want *1-2-3* to look up numbers automatically, modify the menu as shown in Figure 3. Then create a two-column phone list, with the names in the first column and the phone numbers in the second col-

DIALNUM.WK1 — COMPLETE LISTING

```
     A                B                                    E
1    \M               {Menubranch DIALMENU}
2
3    DIALMENU         [illegible]                          Cell_Location
4                     Dial a Number                        Dial number at current cursor location
5                     {Getlabel "Enter number to dial:  ",NUMBER}~ {Let NUMBER,@Cellpointer("Contents")}~
6                     {Branch DIAL}                        {Branch DIAL}
7
8    NUMBER           853-1212
9    QUOTES           "
10
11
12
13   DIAL             {System "MODE COM1:1200>NUL"}
14                    {Indicate Dialing 853-1212 * Press any key after dialing *}
15                    {Open com1,W}
16                    {Writeln "ATDT 853-1212"}
17                    {Get KEY}{Esc}
18                    {Writeln "ATH"}
19                    {Indicate}
20                    {Quit}
21
22   KEY
```

Figure1: Press Alt-M and this *1-2-3* macro displays a menu. The menu lets you enter a number or select the one at the cursor. The macro then dials the number to your modem.

DIALNAME.WK1 COMPLETE LISTING

```
     A                    B                                    C                    D                    E
\M       {Menubranch DIALMENU}

DIALMENU Number                                        Cell Location        Bert                 Ernie
         Dial a Number                                 Dial number at current cursor location  Call my old buddy Bert  Get Ernie on the phone
         {Getlabel "Enter number to dial:  ",NUMBER}"  {Let NUMBER,@Cellpointer("Contents")}"  {Let NUMBER,"123-4567"}  {Let NUMBER,"765-4321"}
         {Branch DIAL}                                 {Branch DIAL}        {Branch DIAL}        {Branch DIAL}

NUMBER   853-1212
QUOTES   "

DIAL     {System "MODE COM1:1200>NUL"}
         {Indicate Dialing 853-1212 * Press any key after dialing *}
         {Open com1,W}
         {Writeln "ATDT 853-1212"}
         {Get KEY}{Esc}
         {Writeln "ATH"}
         {Indicate}
         {Quit}

KEY      4                                    'a place for any key to be stored
```

Figure 2: This macro, an expansion of DIALNUM.WK1, adds the names of two often-called people to the DIALMENU.

DIALLIST.WK1 COMPLETE LISTING

```
     A                    B                                    C                    D
1    \M       {Menubranch DIALMENU}
2
3    DIALMENU Number                                        Cell Location        Party
4             Dial a Number                                 Dial number at current cursor location  Enter the name of the party to call
5             {Getlabel "Enter number to dial:  ",NUMBER}"  {Let NUMBER,@Cellpointer("Contents")}"  {Getlabel "Party you want to call: ",PARTY}
6             {Branch DIAL}                                 {Branch DIAL}        {Let NUMBER,@vlookup(@upper(Party),Phonelist,1)}
7                                                                                 {Branch DIAL}
8
9
10
11
12
13
14   PARTY    bert
15   NUMBER                                         ERR
16   QUOTES   "
17
18   DIAL     {System "MODE COM1:1200>NUL"}
19                                                  ERR
20            {Open com1,W}
21                                                  ERR
22            {Get KEY}{Esc}
23            {Writeln "ATH"}
24            {Indicate}
25            {Quit}
26
27   KEY      {ESC}
28
29   PHONELIST BERT                                      111-1111
30             BETTY LOU                                 222-2222
31             BIG BIRD                                  333-3333
32             ERNIE                                     444-4444
33             GROVER                                    555-5555
34             KERMIT                                    666-6666
```

Figure 3: A custom *1-2-3* menu can display only eight options. If you want more, use this DIALLIST macro. DIALLIST adds the option Party to the original DIALNUM menu. If you choose Party, the macro moves to the PHONELIST range. You can then choose the name of the person you want to call. The above are only illustrative; you should replace them with your own list.

umn. Name this list PHONELIST.

The third version of the macro uses the @VLOOKUP function to get a telephone number for the party you want to call. Because this function discriminates between lowercase and uppercase letters, it's best to use all capitals in the first column of your phone list. Then use @UPPER to force the first argument of the @VLOOKUP function to be uppercase.

If you follow these guidelines, you'll be able to specify names in any capitalization mode. You will still need to spell the name of your party exactly as it appears in the phone list, however. Therefore, it's best to keep the names as simple as possible. Don't enter Big Bird Jones if Big Bird will do.

The names in your phone list must be in alphabetical order. You can use the /Data Sort command to help you set this up. And the range name PHONELIST must encompass the entire list, not just the first cell.

If you specify a name that isn't on the list, or your names are not in alphabetical order, the macro will still go out to DOS to initialize the modem. The cell named NUMBER will hold ERR, however, and no dialing will take place.

HINTS, TIPS, QUESTIONS

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CIRCLE 366 ON READER SERVICE CARD

by
Costa Rodis

The Working Word

DROP CAPS

I produce a newsletter that requires drop caps. So I've created a *WordPerfect* 5.1 macro that lets me generate them easily and quickly. Press Alt-D and the macro prompts you for a letter. The one you enter is then scaled to 46-point type, enclosed in a graphic box, and deposited at the left margin. The box width changes to accommodate different characters. The paragraph in Figure 1 shows an `I` generated by the macro.

I use W (1/1200 inch) as the unit of measure and a base font of 10-point Times Roman. The capital is then exactly three lines high. The top of the character lines up with the top of the paragraph's first line; the bottom of the character lines up with the bottom of the third line. If you want a drop cap of a different size, you can adjust the point size of your base font as well as the values of the *Height, Points, Advance,* and *Width* variables.

If you're working with a document that uses columns of text (such as a newspaper), I have one caution. You should insert the drop cap *before* the [Col On] code. Otherwise, the first column will start slightly below the others. Unfortunately, if you position the cursor immediately before [Col On] and then run the macro, the codes generated will straddle the [Col On] code. In this case, you simply have to move them all in front of [Col On].

Nick Payne
Canberra, Australia

- DROP CAPS: A *WordPerfect* 5.1 macro makes them easy to create.
- WORDPERFECT 5.1 IN ANY LANGUAGE: Choose from 21 languages to format dates, time, file listings, and other information.

PC MAGAZINE Mr. Payne's clever down-under macro (shown in Figure 2), was designed to work with PostScript fonts. But any on-the-fly, scalable font technologies, such as Glyphix or Bitstream's Speedo, should work equally well.

The macro assumes that *WordPerfect*'s Units of Measure option is set to 1/1200 inch (W). Although the inch is the default setting, W is the true *WordPerfect* 5.1 unit of measure. 1/1200 inch is, after all, far more exact than a full inch, which is accurate to only two decimal places. Aside from inches and 1/1200 inch, Units of Measure can be set to centimeters, points, or *WordPerfect* 4.2 Units. Simply select Setup (Shift-F1), Environment, and Units of Measure. Then choose the setting you want. Keep in mind that the unit of measure not only affects the display at the bottom of the normal text screen, but it also changes the appearance of margin, tab, and page size formats. Setting formats with points or 1/1200-inch units can be quite a challenge!

Since most people use inches, I've added a line at the beginning and end of the macro. One changes the environment to W during the creation of a drop letter; the other returns the Units of Measure to inches afterward. You can edit these lines to reflect the units of measure you typically use.

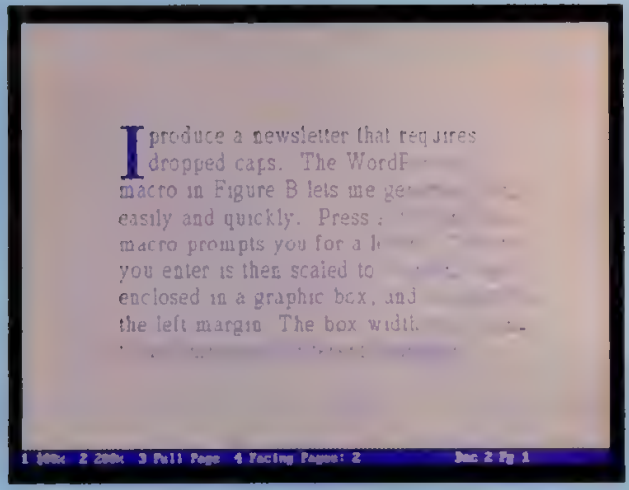

Figure 1: The dropped cap `I` in this paragraph was generated by the *WordPerfect* macro shown in Figure 2.

WORDPERFECT 5.1 IN ANY LANGUAGE

In his letter "Spanish Style" (May 15, 1990), Robert Caro offered a macro that converts dates from English to Spanish. I was surprised that you didn't suggest using the language code and related *WordPerfect* language resource file to make the change.

The solution is simple enough. Just select Format Other and Language (Shift-F8, O, L in *WordPerfect* 5.1) and enter the abbreviation of the language you want to use—the program offers 21 in all. For the language format, *WordPerfect* refers to a database file called WP.LRS. This file contains all language-specific information and is in *WordPerfect* 5.0 secondary merge format. Fields 1 through 8 indicate the particular language code selected; fields

The Working Word

9 through 27 list the different formats in the specific languages. *WordPerfect* uses the information in this file as default entries for many features, such as the date and time display or the entries in List Files.

You can browse or edit the WP.LRS file from the normal *WordPerfect* screen (you can also make changes from Notebook, if you use *WordPerfect* Library or Office). On the normal *WordPerfect* screen you will notice the Notebook header, which you must be very careful not to alter or delete. Other than that, you can edit any record you want. Simply Search (F2) on the language code, a two-character designation such as FR for French or GR for Greek.

I have the US edition, but I live in Italy, so I find it convenient to use the IT code language to default date codes in Italian. I've made other minor changes, such as modifying the way *WordPerfect* displays file dates in the List (F5) feature. Now, they appear in a DD/MM/YY format. I've also arranged it so that the first letter of week and month names are capitalized.

Gian Luca Sarto
Milano, Italy

ALTD.WPM — **COMPLETE LISTING**

```
{DISPLAY OFF}
{Setup}EUDWSW{Exit}                          {;} units of measure to 1200s~
{ASSIGN}Height~560~                          {;} box height for drop cap~
{ASSIGN}Points~46~                           {;} point size~
{ASSIGN}Advance~35~                          {;} amount to advance up and down~
{CHAR}Char~{^}}Enter character for Dropped Cap:{^\} ~
{ON CANCEL}{QUIT}~
{CASE}{VARIABLE}Char~~                       {;} box width varies according to char~

  A~CA~a~CA~C~CA~c~CA~D~CA~d~CA~N~CA~n~CA~R~CA~r~CA~U~CA~u~CA~
  V~CA~v~CA~X~CA~x~CA~Y~CA~y~CA~
  B~CB~b~CB~E~CB~e~CB~L~CB~l~CB~T~CB~t~CB~Z~CB~z~CB~
  F~CF~f~CF~P~CF~p~CF~
  G~CG~g~CG~K~CG~k~CG~O~CG~o~CG~Q~CG~q~CG~H~CG~h~CG~
  I~CI~i~CI~
  J~CJ~j~CJ~
  M~CM~m~CM~
  S~CS~s~CS~
  W~CW~w~CW~
  ~
{QUIT}                                       {;} non-alphabetic char~
{LABEL}CA~{ASSIGN}Width~554~{GO}CONT~        {;} set box width~
{LABEL}CB~{ASSIGN}Width~511~{GO}CONT~
{LABEL}CF~{ASSIGN}Width~468~{GO}CONT~
{LABEL}CG~{ASSIGN}Width~596~{GO}CONT~
{LABEL}CI~{ASSIGN}Width~298~{GO}CONT~
{LABEL}CJ~{ASSIGN}Width~383~{GO}CONT~
{LABEL}CM~{ASSIGN}Width~724~{GO}CONT~
{LABEL}CS~{ASSIGN}Width~426~{GO}CONT~
{LABEL}CW~{ASSIGN}Width~767~
{LABEL}CONT~
{Graphics}34                                 {;} set box options~

11111
20{Enter}
3{Enter}
3{Enter}
3{Enter}
30{Enter}
3{Enter}
3{Enter}
3{Enter}
90{Enter}
{Enter}
{Format}411{VARIABLE}Advance~{Enter}{Enter}{Enter}
{Graphics}31                                 {;} create box for drop cap~
61
73{VARIABLE}Width~{Enter}{VARIABLE}Height~{Enter}
9{Font}4ntimes roman bold{Enter}{Enter}
{VARIABLE}Points~{Enter}
{VARIABLE}Char~{Left}{Block}{Right}
{Switch}1                                    {;} make char upper case~
{Exit}{Enter}
{Format}412{VARIABLE}Advance~{Enter}
{Enter}{Enter}
{Setup}EUD"8"{Exit}                          {;} units of measure to inches~
```

Figure 2: This macro scales a letter to 46-point type, encloses it in a graphics box, and deposits it at the left margin. If you want to change the font or size of your drop cap, you can adjust the base font as well as the macro's Height, Points, Advance, and Width variables.

DATE FORMATS

Language	Code	Date Format
Spanish	ES	2 de octubre de 1990
French	FR	2 octobre 1990
Greek	GR	2 Οκτώβριος, 1990
Italian	IT	2 ottobre, 1990
Russian	RU	2 октября 1990 г.

Figure 3: You can select different language formats for the date (shown above), time, and other *WordPerfect* displays.

As Mr. Sarto has suggested, you can augment *WordPerfect*'s language abilities with the WP.LRS (language resource) file. Those who use another date format need only follow these instructions for changing the language code:

Go into Formats (Shift-F8), Other, Language. Type the two-letter code for the appropriate language: ES for Spanish, FR for French, GR for Greek, RU for Russian, and so on. Once this is done, press Shift-F5 and tap T or C to automatically insert the current date. Figure 3 shows the date that *WordPerfect* can generate in Spanish, French, Greek, Italian, and Russian.

If the foreign characters being created are not part of the standard ASCII set, you may see a rectangular bullet (■). Those users with EGA or VGA who select the 512 characters option from Setup (Shift-F1) can see 256 of those characters that would normally be invisible. If you want to see any character that does not appear on the screen, simply view it with Print View (Shift-F7, V).

When another language is selected, *WordPerfect* automatically looks for the spelling dictionary for that particular language. If you use another language frequently, it may be valuable to purchase the appropriate spelling dictionary from *WordPerfect*.

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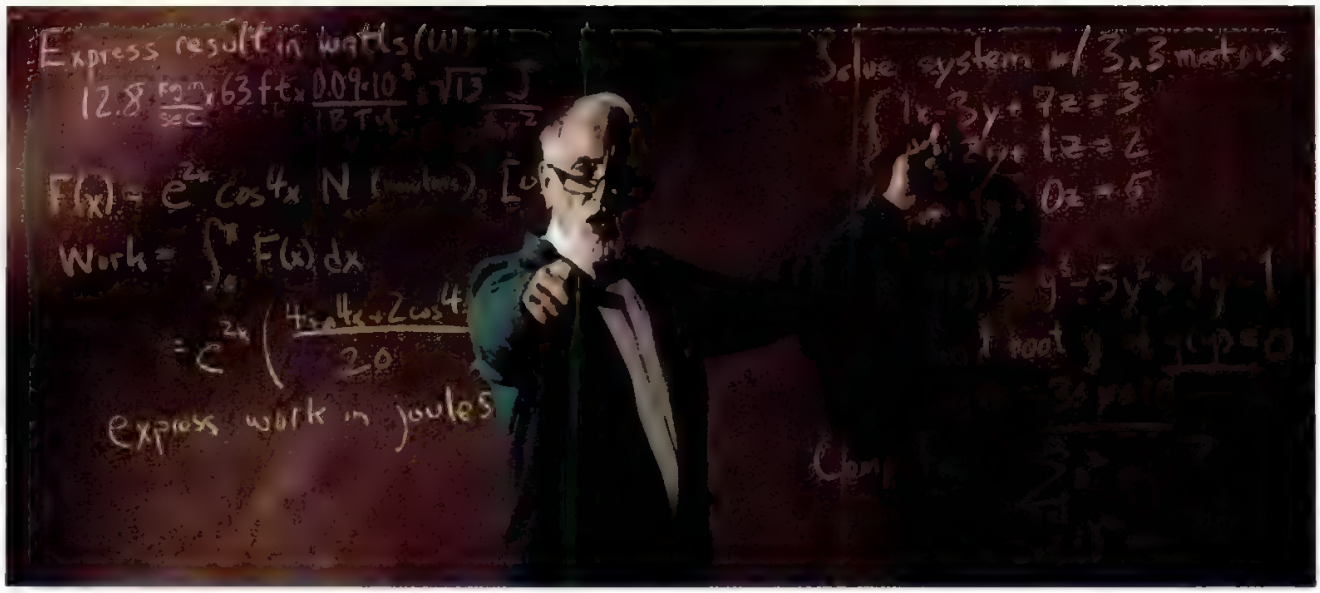

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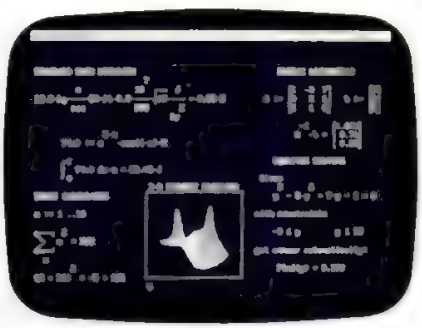

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CIRCLE 154 ON READER SERVICE CARD

by
Neil J. Rubenking

User-to-User

DISPLAYING MORE TEXT

Most users are familiar with the 43-line mode available on the EGA adapter and the 50-line mode on the VGA. Both of these modes are created by using the CGA character set, which occupies only 8 scan lines on the screen. On the 200-scan-line CGA, this corresponds to 25 lines of text. The 350-scan-line EGA yields 43 text lines, and the 400-scan-line VGA gives 50 text lines.

As useful as this is, the text produced is very small and can be difficult to read. Sometimes you really don't need that many lines. I recently created an application for a VGA system that required just a couple of extra lines to display some status information. That was when I hit upon the idea of a 28-line mode for VGA.

Just as the 43- and 50-line modes use the lower-resolution CGA font on a higher-resolution screen, the 28-line mode uses the EGA font on a VGA screen. The EGA font occupies only 14 scan lines, compared with the 16-scan-line VGA font, and on a VGA screen this yields 28 lines of text.

However, unlike the other modes, this one is very readable. The EGA font is quite clear and easy on the eyes. In fact you may not even notice that you've loaded a new font, until you count the number of lines on the page. Figure 1 is a listing of a DEBUG script to create VGA28.COM, which will establish the 28-line mode.

Charles C. Edwards
Alexandria, Virginia

- **DISPLAYING MORE TEXT:** VGA users can now display 28 lines of text on-screen, thanks to this tiny utility.
- **COPY CONUNDRUM:** DOS 3.3's COPY command doesn't always concatenate text files correctly.
- **FINDING HIDDEN FILES:** The IF EXIST batch command detects files even if they're hidden.

VGA28.SCR (Figure 1) is a series of DEBUG commands that produce VGA28.COM. Create the script using an editor that can save plain-ASCII files, with a carriage return at the end of every line and no control characters. Be sure to include the blank lines before the line NVGA28.COM and after the Q. Now redirect the file into DEBUG with the command DEBUG < VGA28.SCR. If you see any ^Error messages, correct your script and try again.

This 28-line mode isn't "sticky"—any program that resets the video mode will wipe it out. For example, upon leaving any graphics program, you'll be back to 25 lines. If you want to get out of 28-line mode, just use the DOS MODE command to reset your video mode.

Not every program will use the extra lines—for example, DOS ignores them. But there are more and more programs that check the number of text rows and columns your system is using and adapt to them. For example, *WordPerfect* 5.0 has no trouble with 28-line mode. Try your applications to see if they use the extra lines, or write your own programs to take advantage of them.

VGA28.SCR COMPLETE LISTING

```
A 100
MOV  AX,1202  ;set up 400 scan lines
MOV  BL,30
INT  10
MOV  AX,0003  ;set up normal text mode
INT  10
MOV  AX,1111  ;load ega character set
MOV  BL,00
INT  10
INT  20       ;return to dos

NVGA28.COM
RCX
15
W
Q
```

Figure 1: Redirect this script into DEBUG to produce a program that will put your VGA monitor into 28-line mode.

COPY CONUNDRUM

I write database programs and often find it useful to combine all of my program files into one text file. Under DOS 2.0, I could enter the command

```
COPY *.PRG ALL
```

to concatenate all my *dBASE* program files into a file called ALL. I could then look at ALL and find every mention of a particular variable or filename.

This worked perfectly until I switched to DOS 3.3. The COPY command no longer seemed to be reliable. Rarely could I copy all my .PRGs into ALL, sometimes just a few and sometimes only one. Since the whole point was to see every reference, this was useless. It took me quite a while to deduce that the difficulty lies with DOS, not my word processor.

The problem is that COPY has two modes, ASCII and binary. In ASCII mode, the first Ctrl-Z marks the end of the file. In binary mode, COPY reads to the physical end of the file. Instead of concatenating only the text before the Ctrl-Z, the DOS 3.3 COPY command combined each entire file. But my word processor stopped at the first Ctrl-Z.

I finally discovered this discrepancy in the COPY command. If you say

```
COPY A.PRG + B.PRG ALL
```

then DOS 3.3 assumes that A.PRG and B.PRG are text files and it correctly stops reading each file as soon as it sees the first ^Z. But when you enter

```
COPY *.PRG ALL
```

DOS 3.3 decides to treat all the .PRG files as binary, even though the manual indi-

cates that the opposite will happen.

I now get around the problem by first creating ALL as a 1-byte file containing just a space and then entering

```
COPY ALL + *.PRG ALL
```

DOS sees the + sign and knows that it's dealing with text files. This trick works fine.

David Jenkins
Berkeley, California

I couldn't believe this was true, so I tried it—now I'm a believer. DOS 3.3's COPY command *is* different from all other versions from 2.0 through 4.0. To test this, I created text files called A, B, C, and D, each containing an identifying line. I then gave the command

```
COPY ?. ALL
```

and TYPEd the ALL file. Only the lines from files A and B showed on the screen. The data from files C and D was present, but it didn't show up. TYPE stopped at the Ctrl-Z at the end of the line from file B. It seems that the COPY command removes the ^Z from the *first* concatenated file but neglects to do so for the rest.

It's not too hard to work around this bug. Apparently the DOS 3.3 COPY command needs to see a plus sign in order to concatenate correctly. You can use a dummy 1-byte file as described above, or you can use *no* file. The command

```
COPY ,,+?. ALL
```

DOS 3.3's COPY command is different from all other versions, 2.0 through 4.0.

has nothing between the two commas, so DOS takes nothing and concatenates all files matching "?." with it. It's an ugly command, but it does the job. And it may be less trouble than switching to DOS 4.*x*.

FINDHID.BAT — COMPLETE LISTING

```
@ECHO OFF
SET dir=%1
IF '%dir%'=='' SET dir=.
IF NOT EXIST %dir%\NUL GOTO badSubdir
SET Any=NO
IF EXIST %dir%\*.* SET Any=YES
SET NonHid=NO
FOR %%f IN (%dir%\*.*) DO SET NonHid=YES
IF %NonHid%==NO IF %Any%==YES GOTO OnlyHidden
IF %NonHid%==NO GOTO noneAtAll
ECHO There are non-hidden files in %dir%, so I can't
ECHO tell whether there are any hidden ones.
GOTO end
:OnlyHidden
ECHO There are only hidden files in %dir%
GOTO end
:noneAtAll
ECHO There are no files at all in %dir%
GOTO end
:BadSubDir
ECHO "%dir%\" is not a valid subdirectory.
:end
SET dir=
SET NonHid=
SET Any=
```

Figure 2: This batch file uses the IF EXIST test to build a hidden-file detector.

FINDING HIDDEN FILES

Within a batch file, the existence of files can be detected by using the IF EXIST command, for example:

```
IF EXIST *.* ECHO THERE ARE FILES
 IN THIS DIRECTORY!
```

However, this command scans only for directory entries and disregards the file attributes.

I use *PC Magazine*'s utility ATTR to tag certain files with the Hidden attribute. But the IF EXIST command doesn't help me verify that all files in a directory have been tagged. Even if every file is hidden, IF EXIST still gives a positive reply. So I developed the following procedure to detect only nonhidden files:

```
SET ANYFILES=NO
FOR %%C IN (*.*) DO SET
 ANYFILES=YES
IF (%ANYFILES%)==(YES) ECHO There
 are non-hidden files
```

Now I can tell if files in a directory haven't been hidden yet.

Gabi Steinhardt
Ramat-Hasharon, Israel

Sometimes when you try to remove a subdirectory, DOS refuses. It says "Invalid path, not directory, or directory not empty". If DIR doesn't show anything in the directory, one or more hidden files may be present. FINDHID.BAT (Figure 2) uses the technique shown above to detect this situation. First it validates the directory itself by checking for the existence of the NUL device in that directory. NUL is available in any directory, so the only way the test can fail is if the directory is invalid.

Now FINDHID uses a FOR command to test for nonhidden files and an IF EXIST command to test for the existence of *any* files. If there aren't any nonhidden files, either the directory is totally empty or it contains hidden files. The IF EXIST test distinguishes between these cases. If the directory does contain nonhidden files, FINDHID can't tell whether there are any hidden files.

Some applications create hidden files without telling you about them. If you try to delete such an application from your hard disk, you may be unable to remove its directory. DOS's ATTRIB command won't help, because it reports only on the Read-Only and Archive attributes. And not everyone has a copy of the ATTR utility mentioned above. FINDHID.BAT will detect the presence of hidden files without requiring any special utility.

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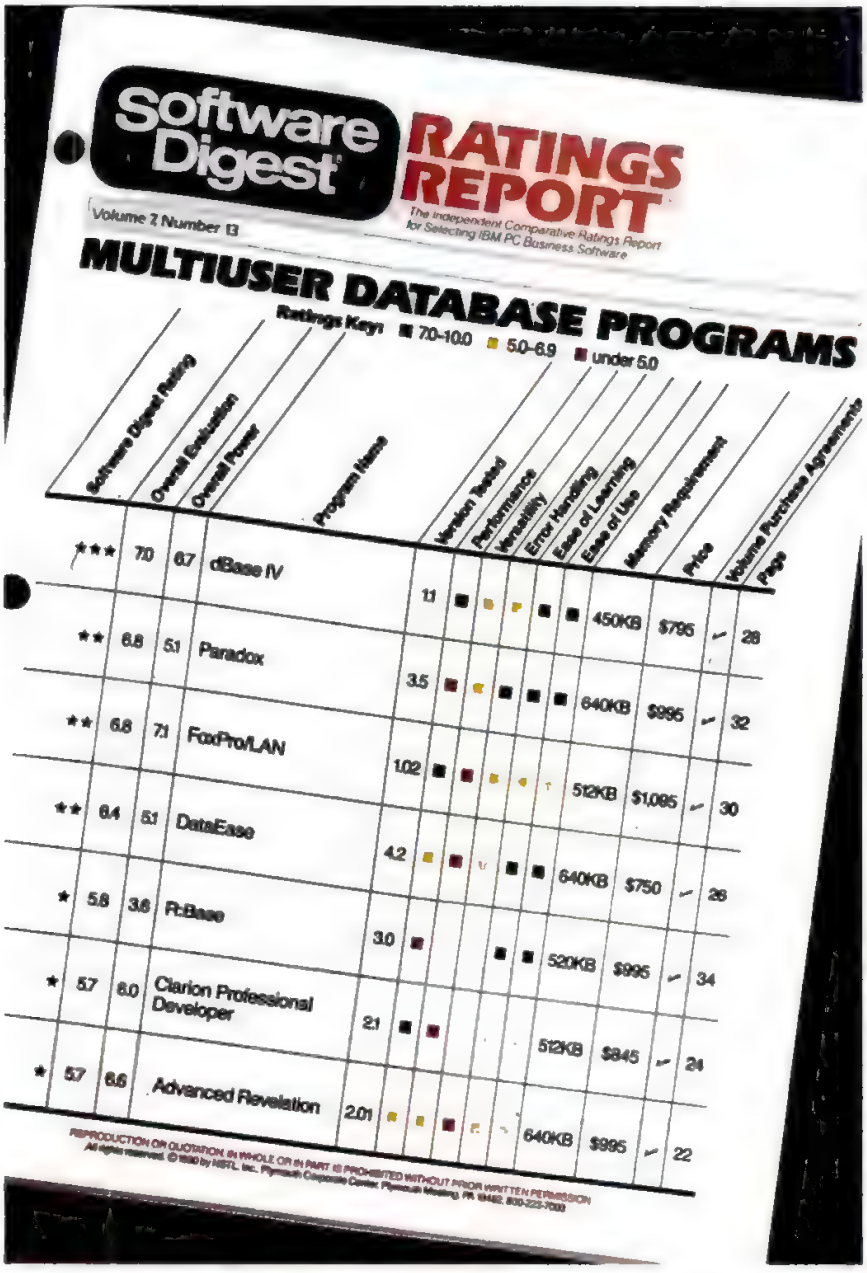

Software Digest RATINGS REPORT

The Independent Comparative Ratings Report for Selecting IBM PC Business Software

Volume 7 Number 13

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Ratings Key: ■ 7.0–10.0 ■ 5.0–6.9 ■ under 5.0

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**	6.8	7.1	FoxPro/LAN	1.02	■	■	■	■	■	512KB	$1,095	✓	30
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*	5.8	3.6	R:Base	3.0	■			■	■	520KB	$995	✓	34
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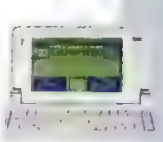

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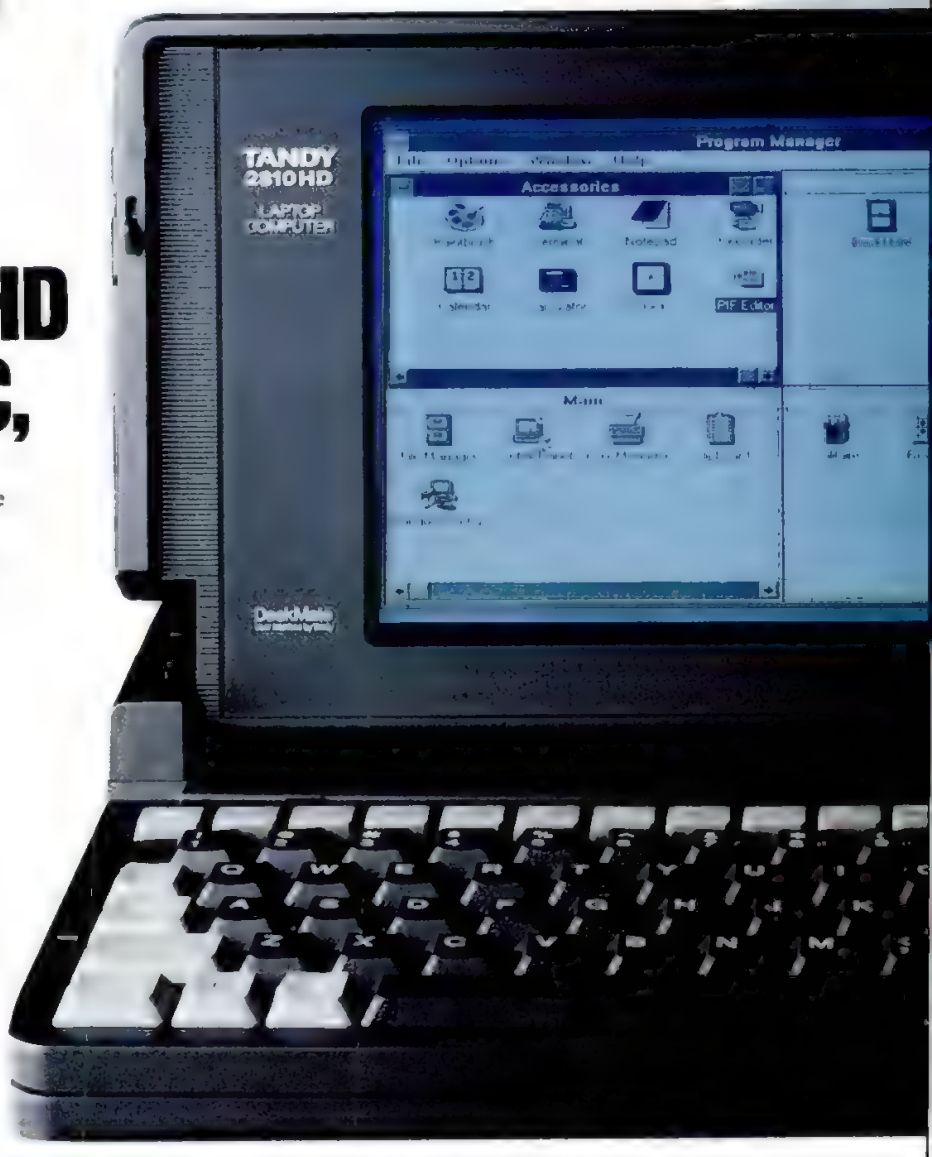

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by
Jeff Prosise

Tutor

MORE ON SHARE.EXE

In the April 24, 1990, Tutor column, you mentioned that DOS 4.0's SHARE.EXE permits you to access drive partitions greater than 32MB. I use MS-DOS 4.01 with a 67MB hard disk set up with the entire disk serving as one DOS partition. I'm not attached to a network, and I don't use SHARE.EXE. I've had no trouble at all accessing files on the hard disk—except for the incessant message DOS displays at start-up warning me it can't find SHARE.

Can you enlighten us a little more on the subject of SHARE.EXE and large partitions? Why does Microsoft say SHARE.EXE must be loaded if you use large partitions under DOS 4.0 when, obviously, it doesn't have to be loaded?

Arthur Pfeffer
New York, New York

PC MAGAZINE It's not strictly true that SHARE.EXE *must* be loaded to access large partitions under DOS 4.0. A better way to say it is that SHARE.EXE *should* be loaded—which explains why DOS 4.0 goes to great lengths to find and load SHARE.EXE if you don't load it yourself.

SHARE's original raison d'être was to arbitrate file accesses in networked environments or in any environment where two programs are likely to grab for the same file at once (as might be the case when you run TSRs that perform file I/O, for example). Used in this manner, SHARE.EXE provides file sharing and locking services and monitors every read and write access to ensure that two processes don't collide.

- MORE ON SHARE.EXE: To be sure your files are safe, it's a good idea to load SHARE, if you use large partitions.
- FORMATTING YOUR DISK: Why your hard disk needs both a low-level and a high-level format.

SHARE took on an additional function in DOS 4.0, however: ensuring that accesses to large partitions by programs using File Control Blocks (FCBs) don't inadvertently destroy data. FCBs are fixed-length data structures that were once used (before the days of file handles) to access disk files. The designers of DOS 4.0 were faced with a dilemma when they added support for partitions larger than 32MB: either alter the format of the FCB to accommodate large partitions (and render existing applications that used FCBs incompatible with the new operating system) or retain the old FCB format and do something else to keep FCB file accesses from destroying data or randomly writing data to a different file. They chose the latter, adding a module to SHARE.EXE that appends an internal file system table to an application's FCBs.

With SHARE.EXE installed, programs that use FCBs to read and write files are as compatible with partitions larger than 32MB as they are with partitions smaller than 32MB in length.

The higher-level file functions introduced in DOS 2.0 use file handles rather than FCBs to reference files. This is the preferred method for performing file I/O, but there are some popular DOS applications that still use FCBs, including *SideKick* and *dBASE III Plus*. Even COMMAND.COM gets in on the act: It uses the FCB-based interrupt 21h, function 13h when deleting files.

Unfortunately, it's difficult to tell which programs use FCBs and which do not. Thus the reasoning behind DOS 4.0's conservative approach to loading SHARE any time large partitions are used: When in doubt, assume the worst. Where the integrity of crucial files is concerned, it's better to be safe than sorry.

SHARE may be installed as a TSR either from the command line or with an INSTALL directive in CONFIG.SYS. Loading it from CONFIG.SYS ensures that it's installed early, before any other programs (or TSRs loaded from AUTOEXEC.BAT) get a chance to make FCB calls.

If your hard disk contains large partitions, DOS 4.01 automatically looks for SHARE.EXE in the directory spelled out in the SHELL= statement in CONFIG.SYS or, failing that, in the root directory of the boot drive. If it can't find it, DOS displays the message: "WARNING! SHARE should be loaded for large media" as a final reminder that your files are at risk if you allow programs to access the large partition. It does not, however, prevent you from proceeding, assuming that if you continue, you know the risks—or know for a fact that none of your programs employ FCBs.

One way to tell whether SHARE has been loaded is to type MEM /PROGRAM at the command line and then look for it in the ensuing memory map. Programs may use the code snippet shown in Figure 1 to determine whether or not SHARE is installed. If, on return from interrupt, AL is set to FFh, then SHARE is installed; otherwise, it's not.

DETERMINING WHETHER SHARE.EXE IS LOADED

```
begin_test:             mov   ax,1000h
                        int   2Fh
                        cmp   al,0FFh
                        je    share_installed

share_not_installed:      .
                          .
                          .
```

Figure 1: You can use this code fragment to determine whether or not SHARE is installed. If AL is set to FFh on return from interrupt, then SHARE is installed; otherwise, it's not.

Here's an interesting aside: If you use SHARE in *Microsoft Windows* 3.0's 386 enhanced mode, it must be loaded before *Windows* is started. If you attempt to load it in a DOS prompt window, *Windows* will reply "SHARE already installed," even if SHARE wasn't previously installed. According to Microsoft, this is by design, not by accident. Allowing SHARE to be loaded on a virtual machine risks crashing the system (in *Windows* 386 enhanced mode, DOS applications are run in the Virtual 86 mode of the 386).

FORMATTING YOUR DISK

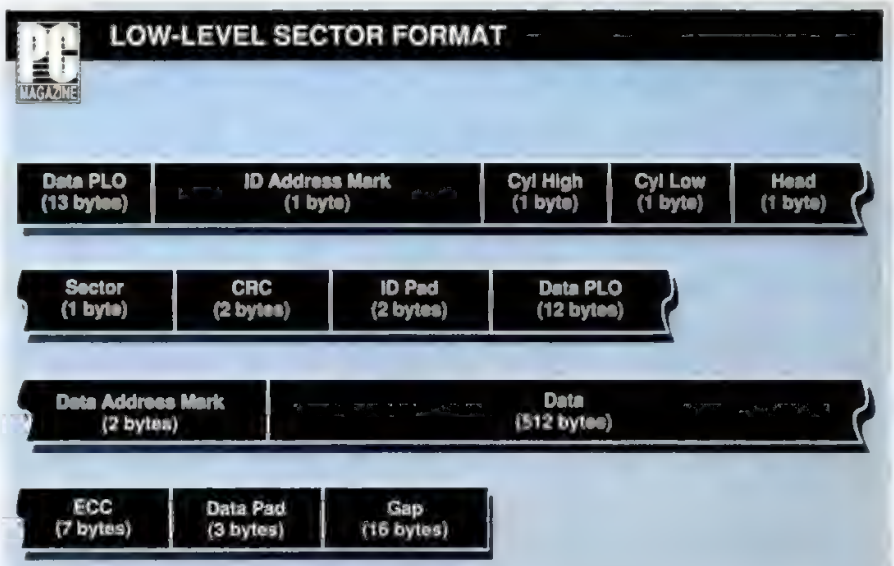
What's the difference between low-level formatting a hard disk and high-level formatting it?

Tim Merrill
Gainesville, Florida

The basic difference between the two types of formatting is that a low-level format works at the controller level to mark off the sectors on a hard disk, while a high-level format works at the operating system level to prepare a disk for use with DOS.

Before a hard disk can be used for the first time, it must be low-level formatted. The low-level formatting process involves having the controller write information to the cylinders of the hard disk defining where the sectors are located and how they're numbered. The exact format of this information varies from controller to controller, but it typically includes a series of synchronization bytes marking the beginning of each sector, ID headers containing head, sector, and cylinder numbers, and CRC (Cyclic Redundancy Check) bytes, used to detect errors in the ID headers.

Figure 2 shows one sector format used by the popular Western Digital WD1003V-MM1 controller. Most marks, with the exception of those in the Data and ECC fields, are written to disk during the low-level formatting process.



Field	Bytes	Description
Data PLO	13	Series of sync bytes (value = 00h) marking the beginning of the sector (and of the ID field)
ID Address Mark	1	A byte (value = A1h) marking the beginning of the ID field
Cyl High	1	Indicates what range of cylinders Cyl Low corresponds to FEh: 0–255 FFh: 256–511 FCh: 512–767 FDh: 768–1023 F6h: 1024–1279 F7h: 1280–1535 F4h: 1536–1791 F5h: 1792–2047
Cyl Low	1	Low byte of cylinder number
Head	1	Head number
Sector	1	Sector number
CRC	2	Cyclical Redundancy Check bytes for detecting errors in ID field
ID Pad	2	Pad (value = AAh) for the ID field
Data PLO	12	Series of bytes (value = 00h) marking the beginning of the data field for the phase-lock oscillator
Data Address Mark	2	Bytes (values = A1h and F8h) marking the beginning of the data field
Data	512	Region where sector data is stored
ECC	7	ECC (error correction code) for fixing up bad data on reads
Data Pad	3	Pad (value = AAh) for the data field
Gap	16	Series of bytes (value = 4Eh) padding out the sector to the proper length

Figure 2: The soft-sector format used by Western Digital's WD1003V-MM1 hard disk controller. Most marks, with the exception of those in the Data and ECC fields, are written to the disk during low-level formatting.

The ID Address Mark, Cyl High, Cyl Low, Head, Sector, and CRC fields collectively form an entity known as the *sector ID*. ID Address Mark marks the beginning of the sector ID. Cyl High and Cyl Low combine to form a cylinder number ranging from 0 to 2,047, but not in the traditional least-significant byte/most-significant byte (LSB/MSB) style. Cyl Low holds the least significant 8 bits of the cylinder number; Cyl High identifies the range of cylinder numbers according to the values shown in Figure 2 (Cyl High and Cyl Low values of FDh and 10h, for example, identify cylinder number 768 plus 16, or 784). The Head and Sector fields identify the head and sector numbers, respectively. And the CRC field holds a 2-byte CRC value used to detect errors in the sector ID.

File data (the data DOS or the BIOS writes to a disk) is stored in the 512-byte Data field. The ECC field that follows holds an error-correction code that permits read errors up to a few bits in length to be corrected by the controller. If not for the ECC, read errors would be far more numerous than we're accustomed to. Data fixes occur in the background, without our knowing about it. The only time DOS notifies the user about a read error is when the error is too large to be corrected by the ECC.

The ID and Data regions of the sector are preceded by Sync fields, which warn the drive's data separator that an address mark is about to pass underneath the drive head. In effect these fields allow the drive electronics to synchronize themselves with the spinning disk. At the controller's discretion, pads and gaps are added to pad out sectors (or fields within sectors) to convenient lengths.

There's more to low-level formatting than meets the eye. Even something as seemingly innocuous as sector numbering is made complex by the need to match the performance of the controller and other components of the system (the bus, DMA controllers, and so forth) to that of the hard disk itself. Sector numbering takes into account factors such as interleaving, head skew, and cylinder skew. These are all designed to keep the controller from missing a sector and having to wait for it to come back around after it moves the drive heads from one cylinder to the next, switches between heads, or finishes processing the last batch of data.

Sector interleave is the separation of consecutively numbered sectors to match the speed of the controller to the hard disk's rate of rotation (on a disk with 3:1 sector interleave, each logical sector is three physical sectors apart).

To illustrate the difference between physical and logical sectors, imagine a row of houses on a street. The first three houses might be numbered 1801, 1805, and 1807. Those are their *logical* numbers. Physically, however, they're the first, second, and third houses on the street. These are their *physical* numbers. On a disk, logical sectors are ordered in the manner that allows the controller to deliver the best performance possible, which might mean that sector 2 doesn't appear after sector 1; there may be other sectors in between.

Head skew is the number of sectors by which sectors on consecutive platters are offset to compensate for the time it takes the controller to switch from one head to the next. *Cylinder skew* is the offset between sectors on adjacent cylinders on the hard disk, included to compensate for the time it takes for a head to seek from one cylinder to the next.

The low-level format also marks bad sectors on the disk so that they won't be used. Some hard disks and controllers require defect maps shipped with the drive to be supplied (read: typed in by you) to the low-level formatting software. (A defect map is simply a list of sectors that the drive manufacturer found to be bad. It's usually just a piece of paper taped to the drive housing.)

That's okay unless the defect list happens to be really long or you lose it and later need to reformat the drive. ESDI drives store defect information right on the disk, so low-level formatting utilities for ESDI drives are able to mark the bad sectors off for you.

That's fine, too, unless additional defects develop over time as a result of normal wear and tear or head crashes. This is why disk-maintenance utilities such as *SpinRite II*, which perform low-level formats nondestructively (without destroying the files already on the disk), also do a thorough surface analysis as they format and mark off any bad sectors they find. *SpinRite II* marks the sector bad, moves the data to a good sector, and, if required, performs any necessary fix-ups to the disk's file-allocation table.

Once the low-level format is complete, all the heads, sectors, and cylinders are clearly defined, but the disk lacks the data structures DOS needs to manage files on the disk. High-level formatting, accomplished with DOS's FORMAT command or a third-party formatting utility such as the *Norton Utilities'* Safe Format or *PC Tools Deluxe*'s PC Format (both discussed in the June 26, 1990, Tutor column), sets up these data structures. They include the following:

- the *boot sector*, which contains a table of information defining the characteristics of the formatted disk (number of bytes per sector, sectors per cluster, sectors per cylinder, and so on) and the bootstrap code that reads DOS into memory on system-formatted disks and diskettes;
- the *file allocation table* (two copies), where DOS keeps track of the physical location of the files on the disk;
- the *root directory*, where filenames, directory names, and related information are stored; and
- the *data area*, where files are stored.

If you need them to, most high-level formatting utilities will also copy the DOS system files IBMBIO.COM, IBMDOS.COM, and COMMAND.COM (the first two are named IO.SYS and MSDOS.SYS in some versions of MS-DOS) to the disk and add a volume label for the purpose of identification.

Keep in mind that disk partitioning, which was discussed in the September 11, 1990, Tutor column, takes place *after* low-level formatting but *before* high-level formatting.

Partitioning divides the disk into several smaller logical disks. High-level formatting works within partition boundaries. As a result, different partitions on the same hard disk can be high-level formatted for use with different operating systems. That's why Microsoft introduced the MS-DOS partitioning scheme in the first place.

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. General questions about DOS and operating systems are answered here. To have your question answered, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload it to PC MagNet (see page 8 for access instructions). We're sorry, but we're unable to answer questions individually. ■

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by
Frank J. Derfler, Jr.

Connectivity

A REPROGRAMMABLE BOOT ROM

No one ever asked me for a reprogrammable boot ROM, but then again people probably didn't ask for a Jacuzzi or a potato peeler before they were available either. For those of you who know the joys of booting from a remote boot ROM—including better security and ease of updates for the network administrator—Artisoft has a neat new idea.

Revision D of Artisoft's AE-2 Ethernet adapter (a clone of the Novell NE-2000, only better) has an in-socket re-programmable boot ROM. The company provides drivers for *NetWare* and its own *LANtastic*. If you want to change or upgrade operating systems, you simply execute a program to load the new code onto the ROM. Artisoft says it will make updates available through its electronic bulletin board system as well as by other means.

An additional benefit provided by this EPROM is that it can be loaded with a security program that forces the user to type in a name and password before the system will even boot up! This makes it easy to secure all PCs on either a diskless or disk-based network.

LAN Manager users know that the few boot ROMs sold for the earlier versions of *LAN Manager* are completely useless under Version 2.0. Wouldn't it be nice to simply read in a diskette to update the silicon? The folks at Artisoft just keep on thinking.

CHOOSING A LAN ADAPTER INTERFACE

Recently, a vendor visited our company to tell us how his Ethernet cards are much better than some others because they use programmed I/O instead of DMA. When we asked about the difference, I'm not sure we got a straight answer. What is the difference between LAN adapters using programmed I/O and those using DMA?

Milly Hummel
Chicago, Illinois

- A REPROGRAMMABLE BOOT ROM: Here's a neat idea that makes changing or updating network operating systems easier.
- CHOOSING A LAN ADAPTER INTERFACE: Get to know the options before you select an adapter.
- CONNECTIVITY AFLOAT: Boating presents special problems for network computing.

PC MAGAZINE PCs and LAN adapters use several different techniques to communicate across the data bus. You need to understand the different input/output options in order to balance performance, complexity, and cost when you select adapters.

Modern network adapters use one of four methods to move data between the board and the PC's RAM: programmed I/O, direct memory access (DMA), shared memory, and bus-mastering DMA. Unfortunately, not every interfacing technique works in every PC; for this reason, many adapters allow you to select between at least two different schemes.

Programmed I/O provides an efficient way to move data between the PC and the network adapter. In this scheme, the special-purpose processor on the adapter board controls a shared 8K, 16K, or 32K block of memory. The adapter's processor communicates with the PC's central processing unit through this common I/O location.

Under the programmed I/O architecture, both devices move data quickly by reading and writing to the same block of memory—which functions like the window between the kitchen and the counter in a fast food diner. Just as in the diner, the processor on either side of the shared window rings a bell to signal the presence of something in the window. The bell in this case is a signal called I/O Ready.

The programmed I/O technique uses less memory than some other data transfer strategies. For this reason, many LAN adapters, such as Novell's NE2000, D-Link's DE-250, and LANtastic's AE-2 use programmed I/O as their primary operating mode.

On the downside, to use programmed I/O, the PC must have a processor more powerful than the Intel 8088 and 8086 used in IBM PCs and PC/XTs, because the processor must be able to execute an I/O String Move command, a command that is unique to the 80286 and later chips. An additional problem is that older PCs generate a wait state signal for each 8-bit I/O operation performed, and this reduces throughput.

LAN adapters with a 16-bit interface can take advantage of a zero-wait-state, 16-bit I/O option. Boards like D-Link's DE-250 have this option and can move 16 bits per access cycle.

If you've got the right processor, programmed I/O is the right choice for an adapter interface technique.

Many adapters use the *direct memory access* method (DMA) to move data between the processor in the PC and the processor on the adapter. This alternative is particularly useful for older PCs that have 8086 and 8088 processors. When it receives a DMA request from an adapter or interface card, the PC's processor halts all other operations in order to handle the data transfer.

In early PCs, the DMA signaling channel used a 4.77-MHz timing clock. Unfortunately, newer PCs still use that same clock rate to maintain compatibility with

older adapters, making DMA an inefficient data transfer technique for modern PCs. I recommend you use it only after careful consideration.

Shared memory was devised to overcome the shortcomings of the programmed I/O and DMA techniques. A shared-memory adapter contains memory that the host PC's processor can access directly at full speed with no wait states. Shared-memory adapters offer (in theory) the fastest way to move data to and from an adapter, if the adapter uses a 16-bit interface. But the big catch is that most shared-memory network adapters are 8-bit, because 16-bit adapters often run into memory conflicts with other devices in the PC. The 8-bit adapters can't take full advantage of the high-speed interface.

Despite the fact that the adapters are designed to move data without wait states, many motherboards impose wait states on the region of memory between 640K and 1MB. There are even some fast 386 or 486 PCs that impose as many as 16 wait states.

In other words, the adapter can have the data ready for transfer, but the motherboard tries to do the adapter a favor by killing time. Some of the shared-memory LAN adapters, particularly those using the National 8390 chip set, impose their own extra wait states. Sixteen-bit adapters can signal the CPU to run at zero wait states, but this often causes problems with other boards in the expansion bus.

Shared Memory was devised to overcome the shortcomings of the programmed I/O and DMA techniques.

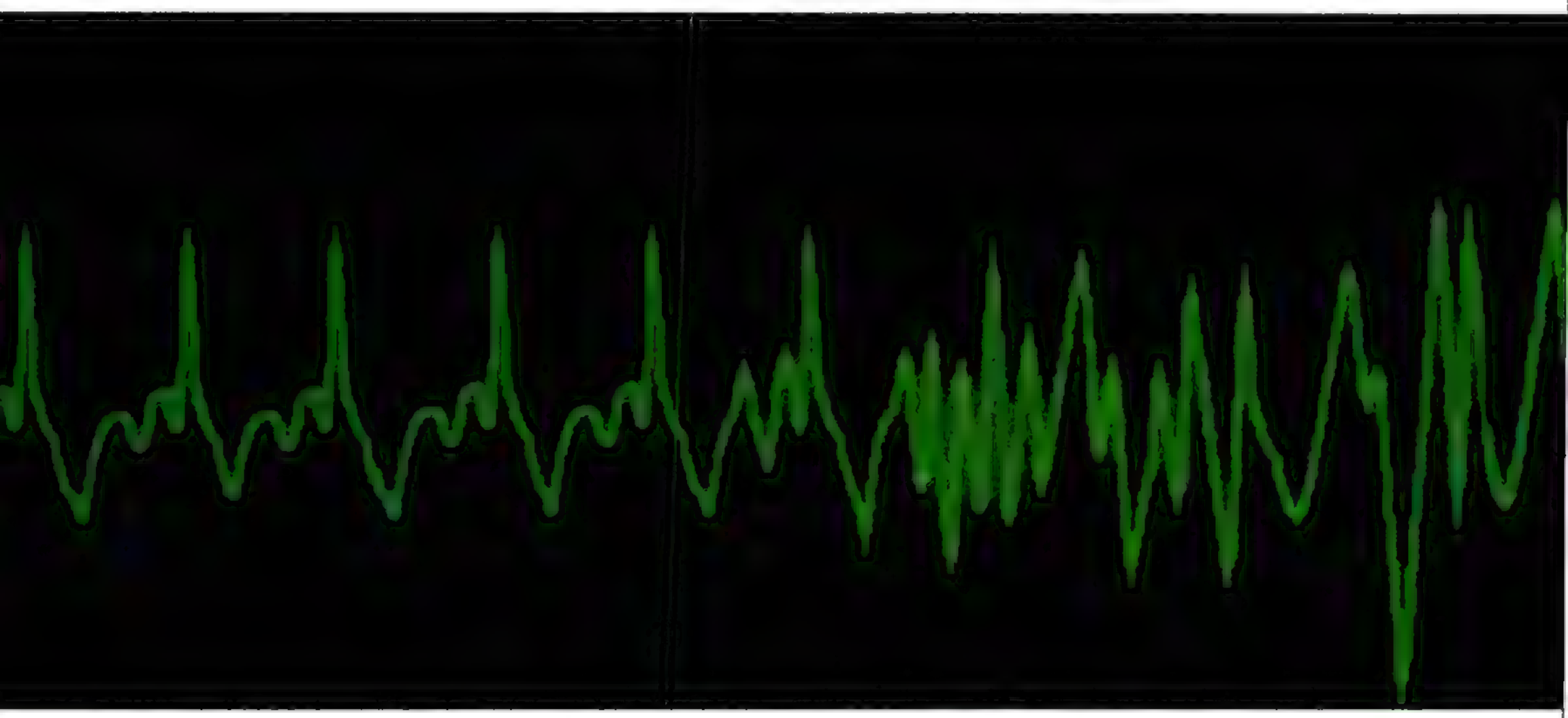
Installing an adapter using shared memory in a PC crowded with a VGA and other memory-hungry interfaces can be a frustrating job. You can run into memory conflicts that manifest themselves only when the LAN adapter and some other device try to use the same location at the same time.

One technique, used primarily on Micro Channel architecture (MCA) and Extended Industry Standard Architecture (EISA) computers, gives a board the ability to transfer data to and receive data from the computer's memory without interrupting the processor at all.

Bus-mastering DMA adapters take over control of the data bus and move data directly between the network adapter and the PC's RAM, while the processor continues its operations. Only a few companies market these adapters because they're expensive and difficult to develop. Typically, you'd buy bus-master adapters only for LAN file servers, although their fast throughput might also enhance workstations used for computer-aided design since graphics workstations often need to move very large files.

CONNECTIVITY AFLOAT

I recently read that you're a boater, so I hope you have some ideas to help us. My wife and I live aboard our boat (a 43-foot



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Pacemaker) and we use it for cruising throughout the year. We also use it as an office. We want to network a couple of laptop PCs and an old Compaq 386/16. Do you have any special suggestions for the wiring or installation?

Kevin Gravley
New Orleans, Louisiana

PC MAGAZINE As any serious boater knows, there are two difficult problems that you're bound to face: corrosion and vibration. The corrosion results from the damp, salty environment along the seacoast, and from stray electrical voltages often present aboard ship because of the galvanic action of the metal and water. I've seen poor-quality coaxial cable connectors turn green in the salt air in a matter of months.

While your Pacemaker won't be pounding along at 30 knots, it will roll, and the engines will cause a constant vibration when you're underway. The single conductor wire used in the center of most coaxial cable is not the best choice in an environment where there's continuous heavy vibration—although it often works in marine VHF radios and LORAN receivers for years. I think I'd trust the unshielded twisted-pair wiring of 10BaseT even less.

I suggest that you explore fiber-optic cabling. Optical Data Systems (214-234-6400) has an excellent selection of couplers for fiber-optic cable that you can secure to the AUI port on practically any Ethernet adapter. IQ Engineering and Xircom make external LAN adapters with AUI ports for the laptop computers.

I'm particularly excited by the release of plastic optical fiber from Codenoll Corp. This new plastic fiber is easier to install than coax and as cheap as unshielded twisted pair. Remember all of those recommendations I've made in past columns about installing unshielded twisted pair? I just might be ready to take them back! We're currently testing some of this new plastic fiber in the PC Magazine LAN Labs, so I'll have more details about it later. But until then, you can contact Codenoll at 914-956-6300 for more information.

I have one more bit of advice: Be sure to secure that Compaq carefully; it may be subject to more stress than you'd ever imagine. I once saw a boat with a crack in the side of its fiberglass hull caused by the sharp corner of a PC that flew across the stateroom during a heavy sea.

I still haven't found a PC I'm totally happy with on a boat. Nearly all of them generate radio frequency (RF) interference into the VHF radio, and they often blank out the LORAN receiver. And it's usually either too hot, too cold, too bright, or too dark for the screen on a laptop. Boating is a tough environment for network computing.

NETWORK YOUR QUESTIONS

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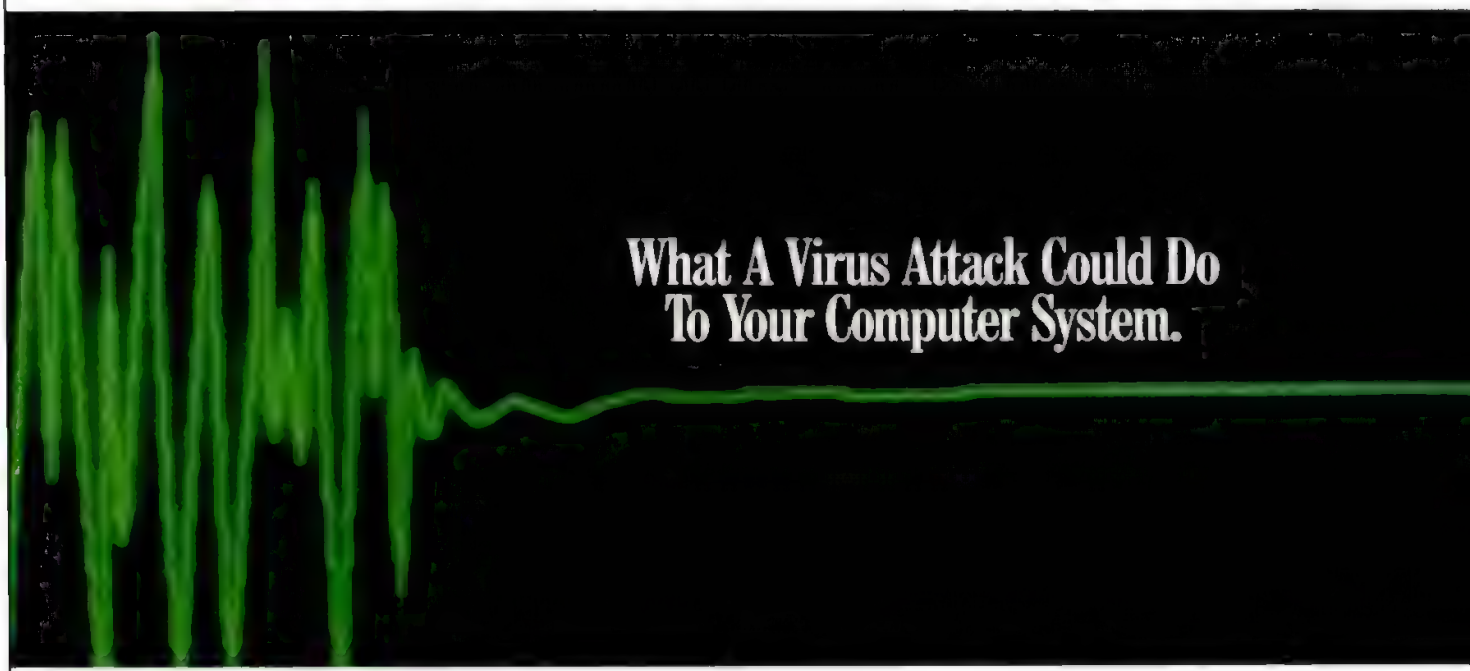

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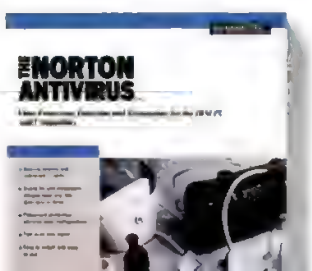

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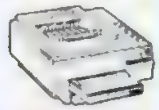

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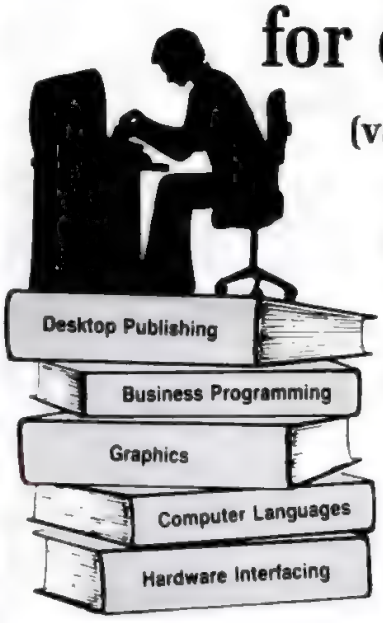

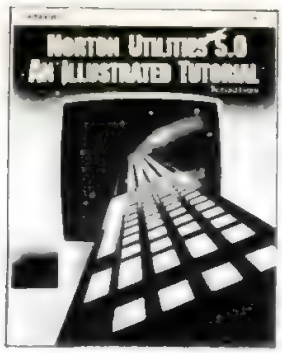

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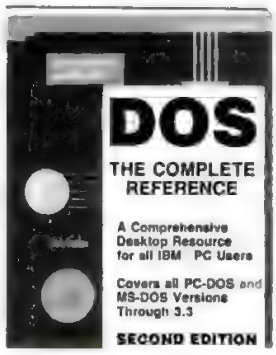

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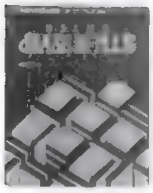

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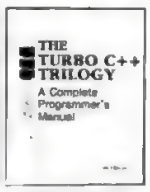

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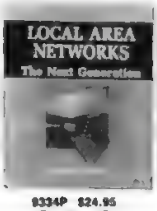

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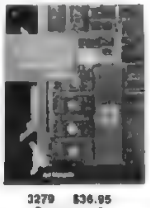

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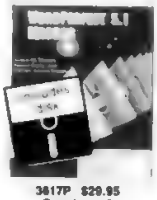

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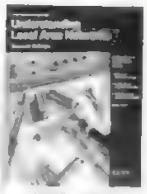

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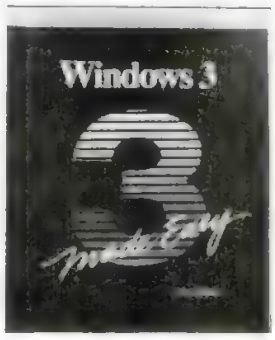

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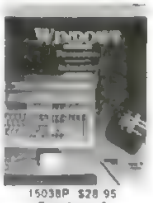

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FastData 386 Systems

FastData 386/33 $2399

The fastest 386 processor available combined with a 64K thirty nanosecond memory cache make the FastData 386/33 a power users dream! Included in the base price is a 100 megabyte 20 millisecond hard disk, 1024 by 768 VGA monitor and card, four megabytes of memory, and 5.25" & 3.5" high capacity floppy drives. Plus, should anything ever go wrong with your FastData computer, you are covered by a one-year warrantee with free on-site service or system replacement if we cannot correct the problem with our FastSHIP advance parts replacement program.

Standard Features

- ✓ 33mhz Intel 386-DX processor.
- ✓ 64K high-speed memory cache.
- ✓ 4 megabytes RAM.
- ✓ 100 mb 20ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" and 1.44mb 3.5" floppy drives.
- ✓ Full size (shown) chassis with keylock, speed and reset buttons.
- ✓ 387-DX coprocessor socket.
- ✓ 230 watt power supply
- ✓ 14" Super VGA color monitor, 1024x768 resolution, with 16 bit VGA card with 512K.
- ✓ Clock calendar, parallel port, game port and two serial ports.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots & 5 drive bays.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ FCC Class B approved.

System Price	65mb	80mb	100mb	200mb
Monochrome	$1,799	$1,929	$1,999	$2,499
VGA Color	$2,099	$2,229	$2,299	$2,599
VGA 1024	$2,199	$2,329	$2,399	$2,699

FastData 386/25 $1999

The optimum combination of features, expandability, and power make the FastData 386/25 an ideal choice for those whose applications demand high speed 32 bit processing and expandability. The value of the 386/25 goes far beyond its price; it comes configured with a a full four megabytes of fast RAM, a quick 22 millisecond 65 megabyte hard disk, and maximum VGA displaying 1024 by 768 resolution powered by a high-output 16 bit 512K VGA board. Also, the FastMicro team will configure your FastData 386 exactly the way you want, without sending you shopping elsewhere.

Standard Features

- ✓ 25mhz Intel 80386-DX.
- ✓ 4 megabytes of zero wait-state RAM.
- ✓ 65 mb 22ms RLL hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive. (For both add $69)
- ✓ Standard chassis (shown on left) with keylock, speed and reset buttons.
- ✓ 80387-DX coprocessor socket.
- ✓ 200 watt power supply
- ✓ 14" Super VGA color monitor, 1024x768 resolution, with 16 bit VGA card with 512K.
- ✓ Clock calendar, parallel port, two serial ports, and game port.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots & 5 drive bays.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ Guaranteed compatible.
- ✓ FCC Class B approved.

System Price	65mb	80mb	100mb	200mb
Monochrome	$1,599	$1,729	$1,799	$2,099
VGA Color	$1,899	$2,029	$2,099	$2,399
VGA 1024	$1,999	$2,129	$2,199	$2,499

FastData 486/25

Call about our hot new 486, just $3,199 with the same standard features as our 386-33 system. Includes a 128K two-stage cache and is expandable to 64mb of memory.

All FastData Systems Include:

- 30 day money- back guarantee
- Toll-free technical support for life
- One year warrantee with on-site service available to most U.S. locations

FastData SX Systems

$1599 FastData SX/20

25% faster than a 16mhz SX, the FastData SX/20 adds even greater performance to its 386 multitasking capabilities. Just $200 more than our SX/16, this machine also includes a second floppy drive in addition to the standard VGA color monitor and 16 bit VGA adaptor, Keytronics keyboard and 40 megabyte hard drive. The system includes two megabytes of memory and is expandable to eight on the main system board. Remember, when you have questions, need to solve a problem, or want recommendations on products for your system, the FastMicro team is standing by toll-free to provide product support for as long as you own your FastData personal computer.

Standard Features

- ✓ 20mhz Intel 80386-SX processor.
- ✓ 2 megabytes of zero wait-state RAM.
- ✓ 40 mb 28ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" and 1.44mb 3.5" floppy drives.
- ✓ Standard chassis (shown) with keylock, speed and reset buttons.
- ✓ 200 watt power supply
- ✓ 14" VGA color monitor with 16 bit VGA card with 256K.
- ✓ Clock calendar, parallel port, two serial ports, and game port.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots, 5 drive bays.
- ✓ 80387-SX coprocessor socket.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ Guaranteed compatible.
- ✓ FCC Class B approved.

System Price	40mb	65mb	80mb	100mb
Monochrome	$1,299	$1,369	$1,499	$1,569
VGA Color	$1,599	$1,669	$1,799	$1,869
VGA 1024	$1,699	$1,769	$1,899	$1,969

$1399 FastData 386/SX

Combine the benefits of an advanced Intel 386 processor, the value of a 286 and the advantages of FastData and you've got the FastData 386/SX! This machine is the choice of those who want to run today's powerful 386 and multitasking software, like Windows, and also want to run their favorite DOS applications at surprising speeds. We've made our customers' favorite options standard: it comes with an ample two megabytes of memory, a high performance 40mb hard drive, and 16 bit color VGA. Compare performance, features, and service and you will find no better SX value. Interested further? Try the FastData 386/SX for 30 days; you have to be happy - if not, we'll take it back.

Standard Features

- ✓ 16mhz Intel 80386-SX processor.
- ✓ 2 megabytes of zero wait-state RAM.
- ✓ 40 mb 28ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive. Both drives add $69.
- ✓ Standard chassis with keylock, speed and reset buttons (mini desktop shown - add $50).
- ✓ 200 watt power supply
- ✓ 14" VGA color monitor with 16 bit VGA card with 256K.
- ✓ Clock calendar, parallel port, two serial ports, and a game port.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots, 5 drive bays.
- ✓ 80387-SX coprocessor socket.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ Guaranteed compatible.
- ✓ FCC Class B approved.

System Price	40mb	65mb	80mb	100mb
Monochrome	$1,099	$1,169	$1,299	$1,369
VGA Color	$1,399	$1,469	$1,599	$1,669
VGA 1024	$1,499	$1,569	$1,699	$1,769

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Conner *(see IDE controllers below)*
CP3044 40mb IDE 28ms 269
CP3104 100mb IDE 25ms 499
CP3208 200mb IDE 25ms 849

Mitsubishi 60mb AT Kit

$349 RLL encoding, 1:1 controller, and 22ms access time make this a quick performer. The perfect upgrade for your 286 or 386 compatible, this kit comes with everything you need including controller and cables.

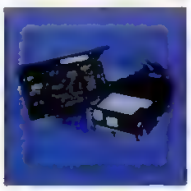
Micropolis
MC1664 340mb ESDI 14ms 1395
Miniscribe 80mb IDE 19ms 479
Mitsubishi 60MB AT RLL MR535 269
NEC CDR-3501 External CD-ROM Drive 399
Plus Development
HardCard IIXL 50 - 52mb 9 ms 16bit 399
HardCard IIXL 105 - 105mb 9 ms 16bit 679
Impulse 42mb 12 ms 16bit IDE Kit 399
Impulse 105mb 9 ms 16bit IDE Kit 599

Toshiba 1.44mb Floppy Drive $79

Complete with mounting brackets and installation instructions, this Toshiba works in all true 286 & 386 compatibles. Will also read/write/format 720K 3.5" disks. Rails, add $5.

Seagate
30MB XT Kit ST238 w/ cont. 249
40MB AT ST251-1 MFM Drive 239
40MB AT ST157A 28ms IDE Drive 249
80MB AT ST296N SCSI Drive w/adaptor 349
89MB ST1102A 19ms IDE Drive 419
125MB ST1144A 19ms IDE Drive 499
210MB ST1239A 15ms IDE Drive 799
330MB ST2383E 16ms ESDI Drive 1289
Tsac
720K 3.5" Floppy 59
1.2MB 5.25" Floppy 65
1.44MB 3.5" Floppy 65

Toshiba $549 100mb IDE Kit



Upgrade your 286 or 386 to IDE technology and Toshiba quality at a FastMicro price. This kit comes with a fast 20ms 105mb drive and built-in 1:1 controller, 16 bit IDE card with dual floppy controller and cables, 5.25" brackets and rails. Call our experts for all your drive needs. Model MK234FC.

Toshiba
360K 5.25" Floppy (Black) 69
1.2MB 5.25" Floppy 69
1.44MB 3.5" Floppy 69
65mb MK134 22ms RLL drive 279
100mb MK234FC IDE 3.5" drive 499
Western Digital Disk Controllers (also see FastData)
WD 16 bit IDE Host - No Floppy/With Floppy 39/49
WD1006V-MM2 MFM AT 1:1 Controller 79
WD1006V-SR2 RRL AT 1:1 Controller 89
WE1007V-SE2 ESDI AT 1:1 Controller 149

Panasonic Super VGA $439

The Panasonic C1381 will do VGA up to 1024x768 interlaced resolution. It has a dot pitch of .28 and is compatible with all standard VGA cards. Includes swivel base and VGA cable

BOARDS

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Lantastic 2mbps Adaptor 169
Lantastic Ethernet Starter Kit - Two Station 499
Lantastic Ethernet Adaptor 239

ATI VGA Wonder + $189

New and improved, the ATI VGA *WONDER+* is faster than VRAM. It does interlaced and non-interlaced 1024x768 modes, is 100% register compatible, and comes with extensive software drivers. A free mouse is included as an added bonus. 512K version $219.

ATI
2400 ETC Internal Call
2400 ETC External 187
9600/E External MNP V.42bis 479
VGA Basic 16 75
VGA Wonder + 256K 189
VGA Wonder + 512K 229
Brown Wagh Sound Blaster 149
Everex
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2400B Int Modem 99
EGA 480 Card 79
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ProDesigner II 512/1mb 279/329
Tiny Turbo 286 207
Tiny Turbo Xtra 267
Paradise
Basic VGA - 8 bit 109
VGA 1024 256K/512K 175/199

Practical Modem 9600SA $449

This external modem features V.42 and MNP error correction combined with MNP/5 and V.42 bis data compression to provide total high speed throughput. The PM9600SA is also V.32 TCM, V.32, V.22 compliant and comes with a five year guarantee too.

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1200B Int Modem 59
2400B Int Modem 125
2400B Int with MNP 169
PM9600SA Ext. V.32/V.42bis 449
Prometheus
Promodem 1200B Internal 48
Promodem 2400B Internal 98
Promodem 2400G External 149
Tiara Networking
Lancard/A PC (Arcnet) 75
Lancard/E Star 8 (Ethernet) 139
Lancard/E AT (16 bit Ethernet) 249
USRobotics
2400 Baud Internal 119
2400 Baud External 147
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VGA 1024i 512K 209
Vega VGA 149
V-RAM VGA 512K 299

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Princeton Call
Seiko CM1440 1450 519 659
Sony 1304 Multiscan 669
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FastData Products

FastData 16 Bit VGA

The FastData 16bit VGA card features 256K of video memory, does CGA, EGA, & VGA up to 1024x768 and comes with drivers for popular software including Windows 3.0. It's expandable to 512K and has a 30 day money-back guarantee. **$95** / **$125**

FastData 16bit 1mb VGA 169
FastData CGA Card 35
FastData MGP Card 29

FastData 2400 Baud Internal Modem

$69 The FastData 2400 baud internal modem is fully Hayes compatible and can be configured to COM port 1-4. It has an internal speaker, is auto answer & auto dial, and comes with BitCom software.

9600B SendFax w/ 2400B Modem 99
MFM 16 Bit 1:1 Hard/Floppy Disk Cont. 59
Parallel/Dual Serial/Game Card 29
RLL 16bit 1:1 Hard/Floppy Disk Cont. 69
XT 1.44 Dual Floppy Controller 35

FastData Monitors

Your best value, we have a complete line made for us by leading manufacturers like Samsung & Hyundai. Like all FastData products you have a full 30 day money back guarantee. Shown is the VGA Color for $279

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14" White VGA Monochrome 129
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14" VGA Color .39 dot pitch 279
14" VGA Color .31 dot pitch 319
14" Super VGA 1024 x 768i .28 dp 349

PRINTERS

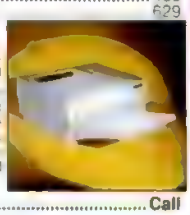
Canon BJ10E 319
BJ300 Call

Citizen GSX140 $285

Loaded with features, this 24 pin printer is a hot seller! It comes with 6 resident fonts, paper parking, and Epson & IBM printing modes. It does up to 192 CPS and has a unique LCD control panel that lets you set everything without DIP switches. Upgrade to color anytime for just $39.

Citizen
200GX 189
GSX140 / GSX145 285/Call
Diconix 150 Plus 329
Fujitsu DL3400 359
NEC
P3200 269
P3300 369
P6200 469
P6300 629

NEC Silentwriter 2 Model 90 $1645



PC Magazine's editor's choice! The new NEC model 90 comes with 2mb of memory, Postscript by Adobe with 35 fonts and parallel, serial and Appletalk interfaces. All this and 6ppm speed, an easy-to-use LCD operator panel and letter, legal, & envelope feed

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Seiko Smart Label Printer 167
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NX1500 299
NX2410 249
XB2410 / 2415 429 / 569
Texas Instruments Microlaser PS35 1699

System Price	40mb	65mb	80mb	100mb
Monochrome	$799	$899	$999	$1,099
VGA Color	$1,099	$1,199	$1,299	$1,399
VGA 1024	$1,299	$1,399	$1,499	$1,599

FastData 286/12 $799

Imagine a fast 286 computer at a super price and you've got the FastData 286/12. This system is complete, not stripped. You get one megabyte of zero-wait-state memory and a 28ms IDE hard disk - standard. Also included is an amber monitor and graphics card, your choice of a high density 1.2mb or 1.44mb floppy drive and a Keytronics keyboard. And since it's a FastData, you are backed with toll-free technical support, one year warranty with the FastShip replacement program & on-site service plan, and our 30 day full money back satisfaction guarantee!

- ✓ 12mhz 80286 processor.
- ✓ 1 megabyte RAM.
- ✓ 40 mb 28ms hard disk 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive
- ✓ Standard chassis (shown with optional chassis - $50)
- ✓ Five drive bays.
- ✓ 200 watt power supply.
- ✓ *287XL* coprocessor socket
- ✓ Monochrome monitor with monochrome graphic board.
- ✓ Clock calendar, parallel port, and two serial ports.
- ✓ Keytronics enhanced 101 keyboard
- ✓ 8 expansion slots, 6 available.
- ✓ Full documentation.
- ✓ FCC Class B approved.

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Clanon Professional Developer	449
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Harvard Graphics $289

The leading business graphics package. Harvard Graphics lets you create superior charts and graphs with ease. Plus, it comes with advanced drawing tools and symbol libraries, imports Lotus spreadsheets, and has advanced 3D features.

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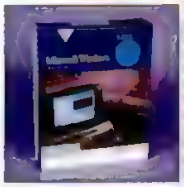

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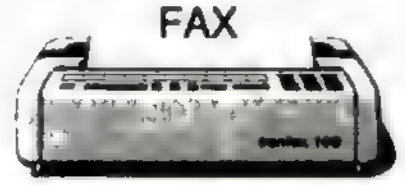

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09. ☐ Education
10. ☐ Government—Federal
11. ☐ Government—Non-Federal
12. ☐ Research and Development
13. ☐ Data Processing/Computer Service
14. ☐ Health/Medical/Legal Service
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14. ☐ Admin./Mgmt.
99. ☐ Other

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01. ☐ Yes
02. ☐ No

5. For how many IBM PCs and compatibles do you specify brands of products:
01. ☐ 10 or less
02. ☐ 11-25
03. ☐ 26-99
04. ☐ 100 or more

6. Are there any PCs in your office?
(Check all that apply.)
01. ☐ Linked to mainframe
02. ☐ Linked to mini
03. ☐ Networked together

7. Please check the equipment currently installed at your location:
(Check all that apply.)
01. ☐ IBM or Compatible PCs
02. ☐ IBM or Compatible Mainframes
03. ☐ IBM or Compatible Minis
04. ☐ Macintosh

8. Do you plan to buy any PC Products?
01. ☐ Now
02. ☐ In 4 to 6 months
03. ☐ In 7 to 12 months
04. ☐ No definite plans

9. Number of Employees in your entire company:
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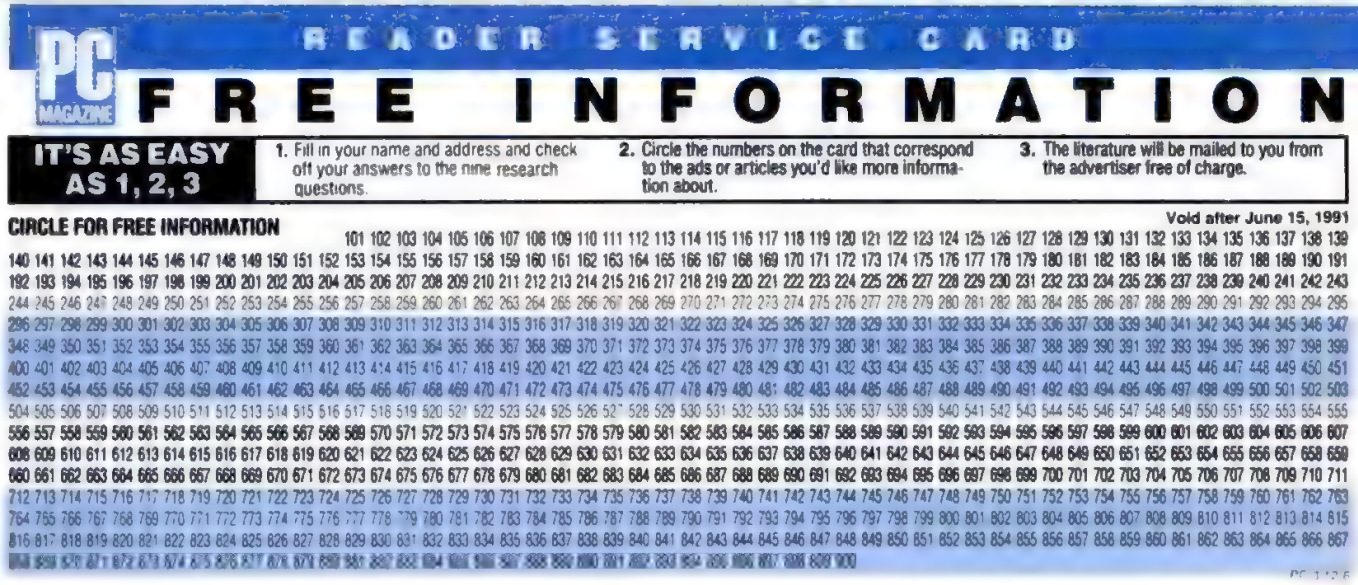

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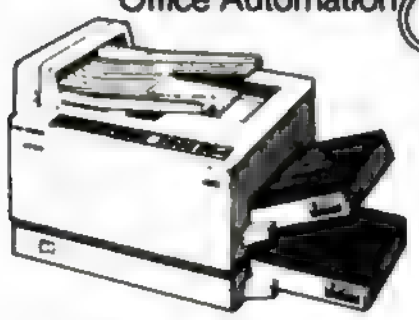

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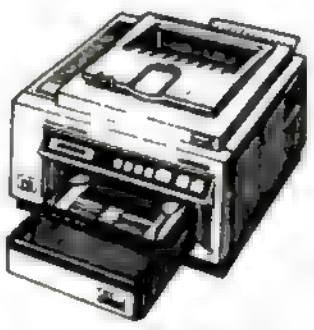

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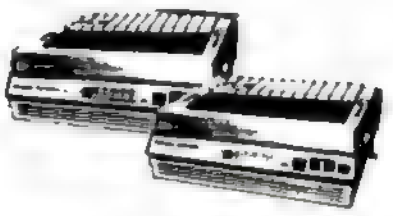

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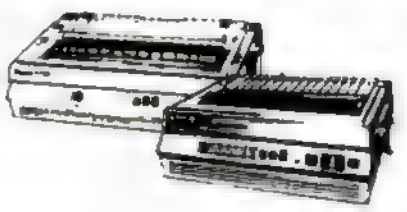

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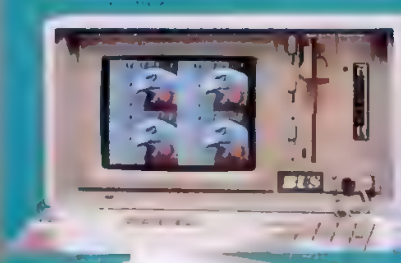

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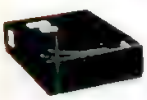

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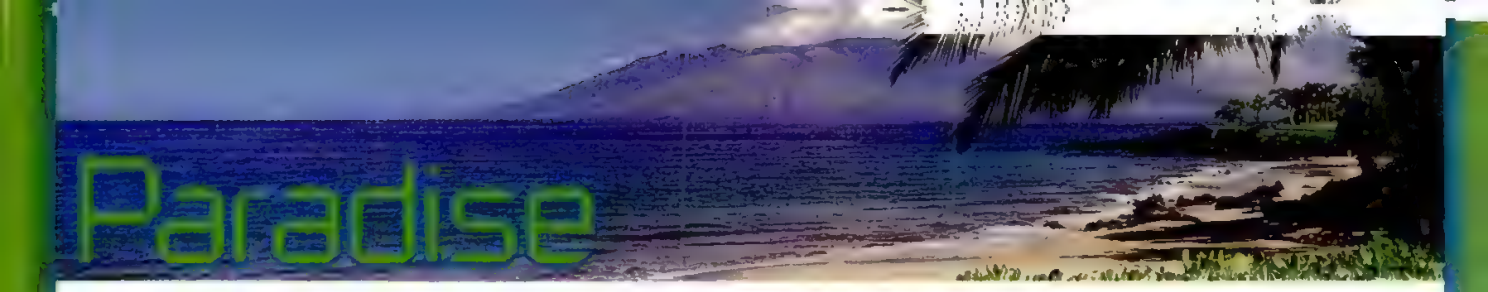

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DeskJet+	$425	7470 Plotter	$450
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All above equipment demo or used with warranty
Call for other HP items not listed

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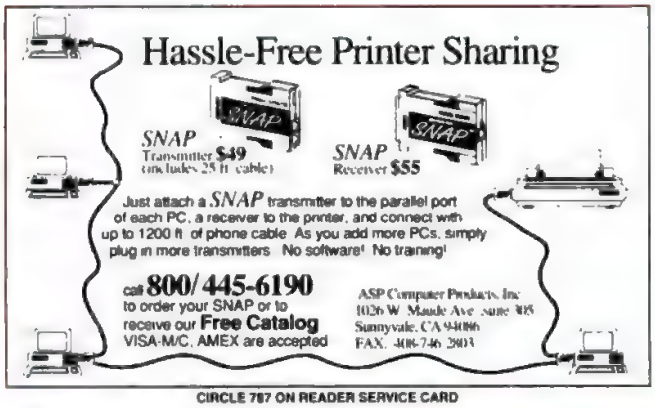
CIRCLE 788 ON READER SERVICE CARD

PRINTERS



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Source: Beta Research Study, 1988
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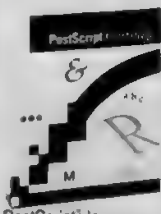

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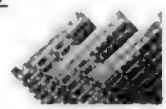

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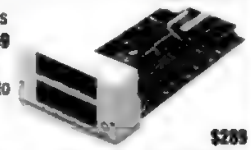

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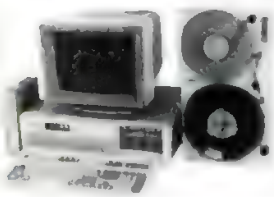

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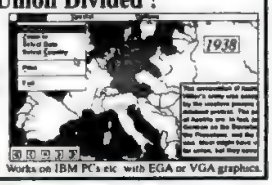

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CIRCLE 804 ON READER SERVICE CARD

ENTERTAINMENT/GAMES
continues on the next page.

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THE SHOWCASE FOR PRODUCTS AND SERVICES IN THE IBM STANDARD MARKET

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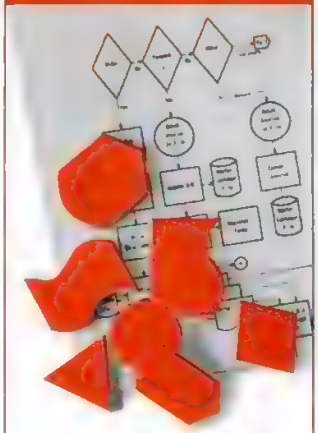

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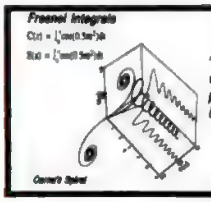

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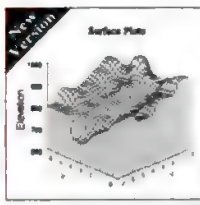

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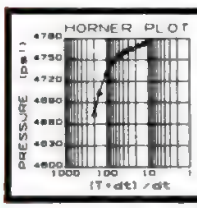

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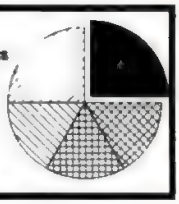

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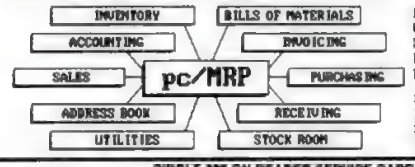

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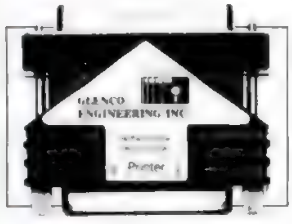

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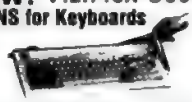

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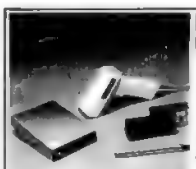

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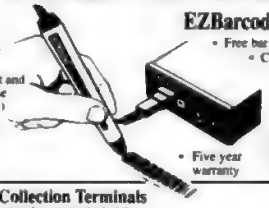

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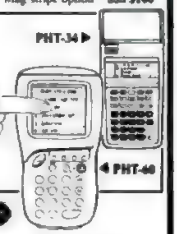

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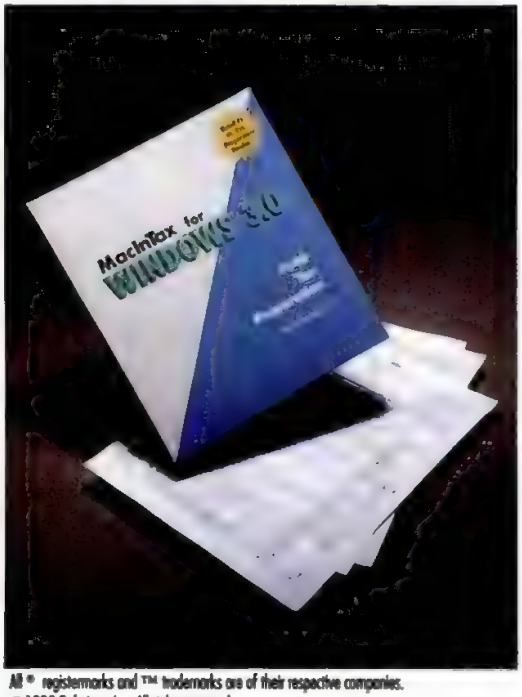

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The Ides of April, Part 2: Four More Tax Prep Packages Help You Deal With the IRS

PERSONAL FINANCE
by Laura Lou Meadows

In this issue, we conclude our yearly assessment of personal tax preparation software for the PC, and tell you how electronic filers can have their refunds in a flash, albeit at a price (see the sidebar "Refund Anticipation Loans: Is the Convenience Worth the Price?"). We also give you a look at the differences between personal tax prep software and the programs the pros use.

AM-Tax

Like a stripped-down, no-frills Speedo bathing suit, *AM-Tax* does the job. This lean, mean program covers the tax territory with a minimum of extraneous details but with great efficiency. *AM-Tax* has no initial interview, no auditor to check out your final effort, no substantive tax instructions, and only minimal on-screen help.

It may not do many of the things that more-sophisticated packages do, but most of what it does, it does quickly and easily with an economy of keystrokes that makes it a joy to use. The *AM-Tax* Personal I edition, for smaller-capacity PCs with 256K RAM, has 18 forms and schedules; the Personal II edition, requiring 320K of RAM, offers 32 forms. As you move from segment to segment with the PgDn or PgUp keys, you tap F6 to access most of the supporting schedules required by the 1040. Only eight forms are listed for direct access on the mini forms menu that appears halfway through your labors.

AM-Tax's depreciation worksheet is clean and fast and applies the proper limitations. The passive activities loss limitations are easily applied by the partnership/S corporation worksheet, but for some of your K-1 items, you will need to decide where they go and enter them directly into the schedule where they ultimately belong.

More notable is the lack of support for electronic filing. While the professional version supports this option, neither personal version of *AM-Tax* allows you to file via modem. That's not a big problem for most taxpayers in 1991, however, and when electronic filing becomes more practical for average taxpayers, AM Software will undoubtedly add this capability to their personal versions.

For the tax preparer of basic to moderately involved returns who already has a laser printer and the old Hewlett-Packard T font cartridge, *AM-Tax* prints IRS-approved replicas of the 1040 and the 1040A. Federal laser drivers, available for $125 from Nelco Software, enable *AM-Tax* to print professional replicas of the rest of the IRS forms it supports. Each of the eight compatible state programs cost $30.

Am-Tax does a competent job of preparing your return, and it may appeal to those who know what they are doing and want to get it done with a minimum of the potentially distracting bells and whistles that some other programs offer. If the help facilities and fancy screen pyrotechnics of more-ambitious packages don't interest you, *AM-Tax*, with its basic, no-frills approach, might well be worth a look.

List Price: *AM-Tax*, Personal I version, $40. Personal II version, $65. **Requires:** 256K RAM for Personal I version, 320K for Personal II version; DOS 2.0 or later. AM Software, P.O. Box 25010, Kansas City, MO 64119; 816-426-8361.

CIRCLE 434 ON READER SERVICE CARD

***AM-Tax*'s no-nonsense approach is reflected in its user interface, which features simple, straightforward menus.**

PERSONAL FINANCE

AM-Tax provides no-nonsense tax prep prowess.

J.K. Lasser's Your Income Tax generates spiffy laser printer output

MacInTax for Windows: heaven for power mouse users.

Personal Tax Preparer: a new entry in the tax prep wars.

J.K. Lasser's Your Income Tax

When you boot up *J.K. Lasser's Your Income Tax*, you are greeted by a colorful splash of menus and the slogan "easy enough for novice—complete enough for professionals." Clearly, this software takes aim at the entire tax software market. It's on target for the novices but, except for its superb laser printing capabilities, *Your Income Tax* has a way to go before it satisfies professionals. (See the sidebar on the difference between "personal" and "professional" tax programs.) One of its strongest selling points is the classic 500-page book, *J. K. Lasser's Your Income Tax*, a copy of which is packaged with the software.

The 1990 version of *Your Income Tax* is based on last year's *Tax Shop* software, which has been expanded and revised by the people at Simon & Schuster with an eye toward creating a real contender. The

CONTINUES

Tax Software

CONTINUED

redesign heavily emphasizes ease of use. Color coding alerts you to which functions are active at any given point in the program, and helps mark the trail through the tax-form jungle. If you want help deciding which forms to file, you run through the interview questions. Your answers prompt *Your Income Tax* to check off the forms you need on the forms menu.

This forms menu is especially easy to use. The title of each form is spelled out next to its number or letter, a great help if you know you need a supporting form for a particular purpose.

Your Income Tax lets you approach a return from either the top down or the bottom up. For the bottom-up route, you choose the forms menu and then pick out the supporting forms checked off by your interview responses. After you complete them, the results flow to the Form 1040.

For the top-down method, you get down to business with the Form 1040 first (or 1040A or 1040EZ if you are filing a simpler return). You pick up the necessary forms along the way by pressing F5 when you get to a line that requires a supporting form or schedule, for example, Schedule B. Then Schedule B appears on the screen for you to fill out. When you're done with Schedule B, F5 takes you back to the 1040 and puts the total of your Schedule B entries on lines 8 and 9, where they belong.

When you find yourself puzzled or uncertain, you can conjure up several different kinds of help, displayed in windows. Among these are notes that prompt you about general tax instructions pertinent to a form you're choosing. Some of these notes pop up automatically.

The interview component of *Your Income Tax* checks off forms that your answers suggest you will need.

On-line help for specific data entry fields gives you exact paragraph-number references to the included book version of the *J. K. Lasser's Your Income Tax* manual. In addition, the on-line help often gives references to IRS publications or other sources. There is also a help menu organized by subject: Tax Topics, Tax Tips, and How to Use Your Income Tax.

This year's *Your Income Tax* does an excellent, step-by-step job of leading you through the process of depreciating an asset and calculating each major aspect. It figures out the amount of the annual depreciation deduction, gets the limitations right, and prints out an asset summary.

In some other technical areas, *Your Income Tax* doesn't quite go the last yard, but at least it has the decency to warn you where it leaves off. It will not calculate the passive activities loss limitation of Form 8582, for example, but if you aren't involved in a tax shelter, no matter.

Pleasing extra features include an easy to operate loan amortizer and the ability (untested by us) to import properly coded data from *Quicken* (the check-writing and financial management program) to the correct lines on the return. Even if you don't plan to file electronically, you can use the validation function that audits your return and gives you a report of any errors or omissions to be corrected.

Your Income Tax includes communications software for electronic filing (to a registered transmitter, not the IRS) by 1,200- or 2,400-bps modem. But unless you are a professional preparer registered with the IRS,

CONTINUES

REFUND ANTICIPATION LOANS: Is the Convenience Worth the Cost?

by Laura Lou Meadows

To encourage you to file your return electronically, the IRS promises to deliver your refund faster—within ten days to two weeks—if you file via modem and have the refund deposited electronically in your bank account.

To create an economic incentive for banks to help taxpayers file electronically, the IRS has agreed to honor an assignment of the refund to a bank. If you assign your refund to a bank, the bank can lend you the amount of your refund with full security. This makes it profitable for a number of banks to offer short-term loans (called refund anticipation loans or RALs) to electronic filers.

How profitable? Suppose you are entitled to a refund of $1,000. The preparer's charge for completing a typical return is in the range of $75; add $30 for the electronic filing. Then add, say, another $70 for the RAL, which brings the total cost to $175. The first $105 of that total would get you your refund in ten days to two weeks, but since you're in a hurry, you spring for the extra $70 for the RAL. Not out of pocket, of course. The preparer subtracts all the charges from the refund and, after the IRS's electronic acknowledgement in a day or two, hands you $825.

What did this cost? If it's only $70 to borrow $825, it may sound like you're paying less than 10 percent (or 8.48 percent). But wait! Interest rates are usually quoted as annual rates. And since the lending bank is paid back by the IRS within two weeks, you've borrowed the money for only those two weeks. Seventy dollars for $825 for two weeks is actually an annual rate of 221 percent! Hey, that sounds like the terms I could get from my friendly neighborhood loan shark!

Doesn't a federal Truth in Lending law apply here somewhere? Sure, but under the Truth in Lending law the bank "assumes" the loan is due in one year (although most are written as due on demand) and discloses a rate of interest based on a one-year maturity. So despite the fact that the IRS will pay off your RAL in two weeks, the bank, with a straight and lawful face, recites that the interest rate is 8.5 percent.

About 87 percent of the taxpayers filing electronically last year paid for a RAL. Who would pay nearly 220 percent for a two-week loan? It's tempting to think that only a financially unsophisticated person would do such a thing. On the other hand, perhaps someone who needs the money immediately would swallow hard and put up with the inflated interest rate. That's a decision each individual must make on his or her own, but it should be made with a clear understanding of the actual costs that are involved. ■

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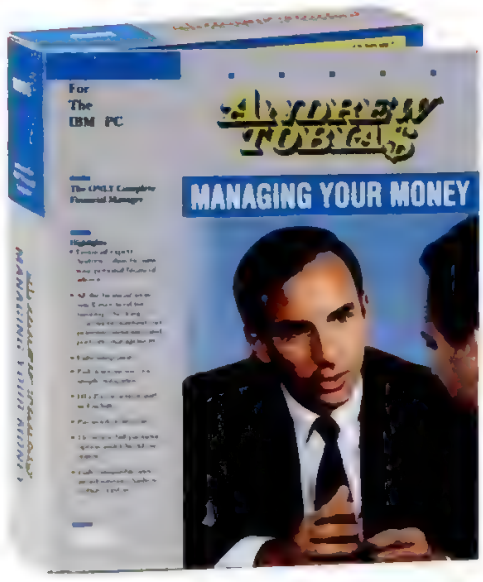

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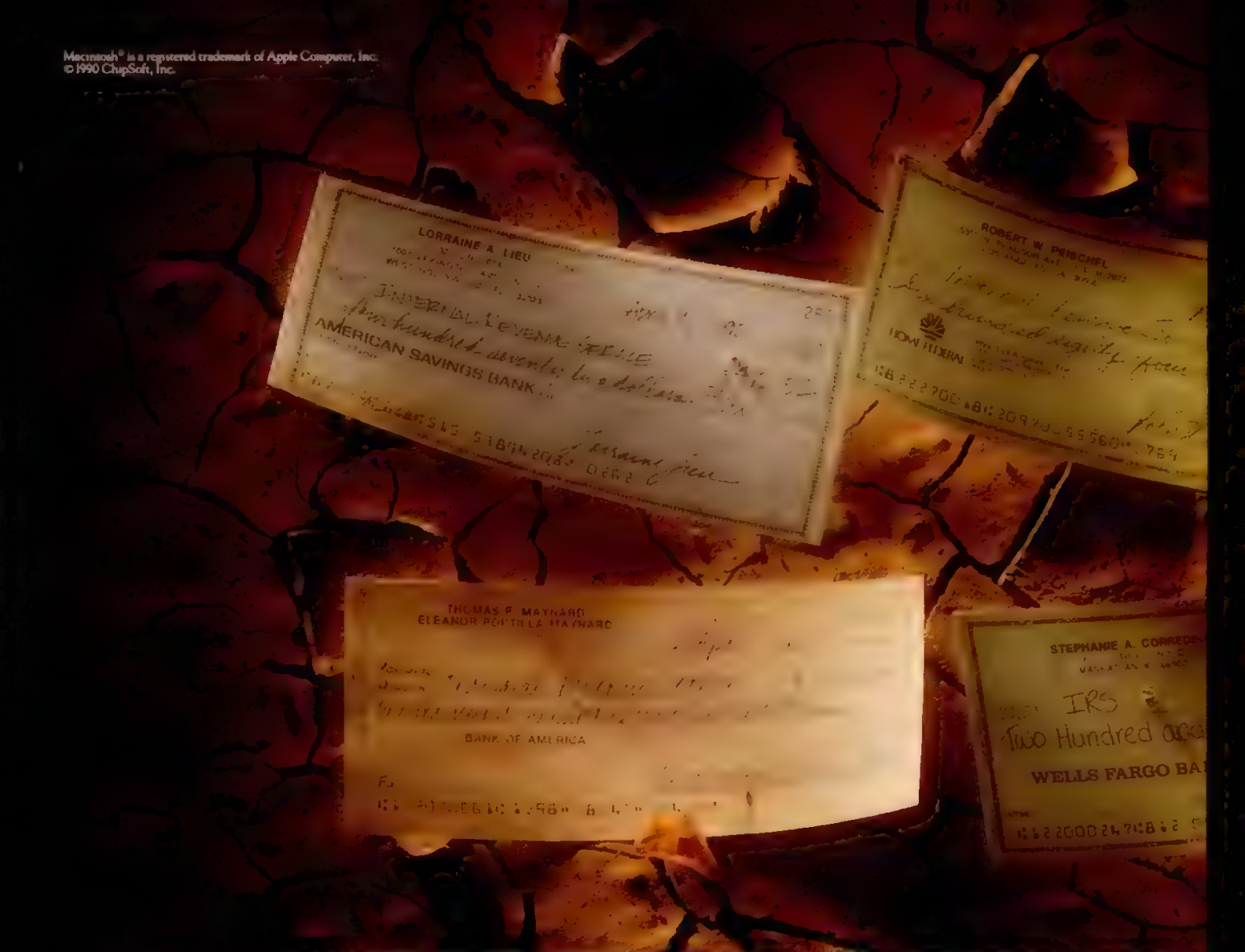

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TurboTax comes complete with over 60 easy to understand federal forms, schedules and worksheets. Easy to understand because TurboTax uses a new hypertext help feature to translate tough tax instructions into plain English.

It lets you compare various tax scenarios. Juggle the figures. Move around deductions. Declare a stock loss this year? No, next year would be even better.

TurboTax guides you to the appropriate line, and shows you how to enter over 90 types of income and expenses. It warns you if any of the numbers you're claiming might flag the IRS. It will proof your return in over 250 areas to check for mistakes in logic, calculation, and identify any potential missed savings opportunities.

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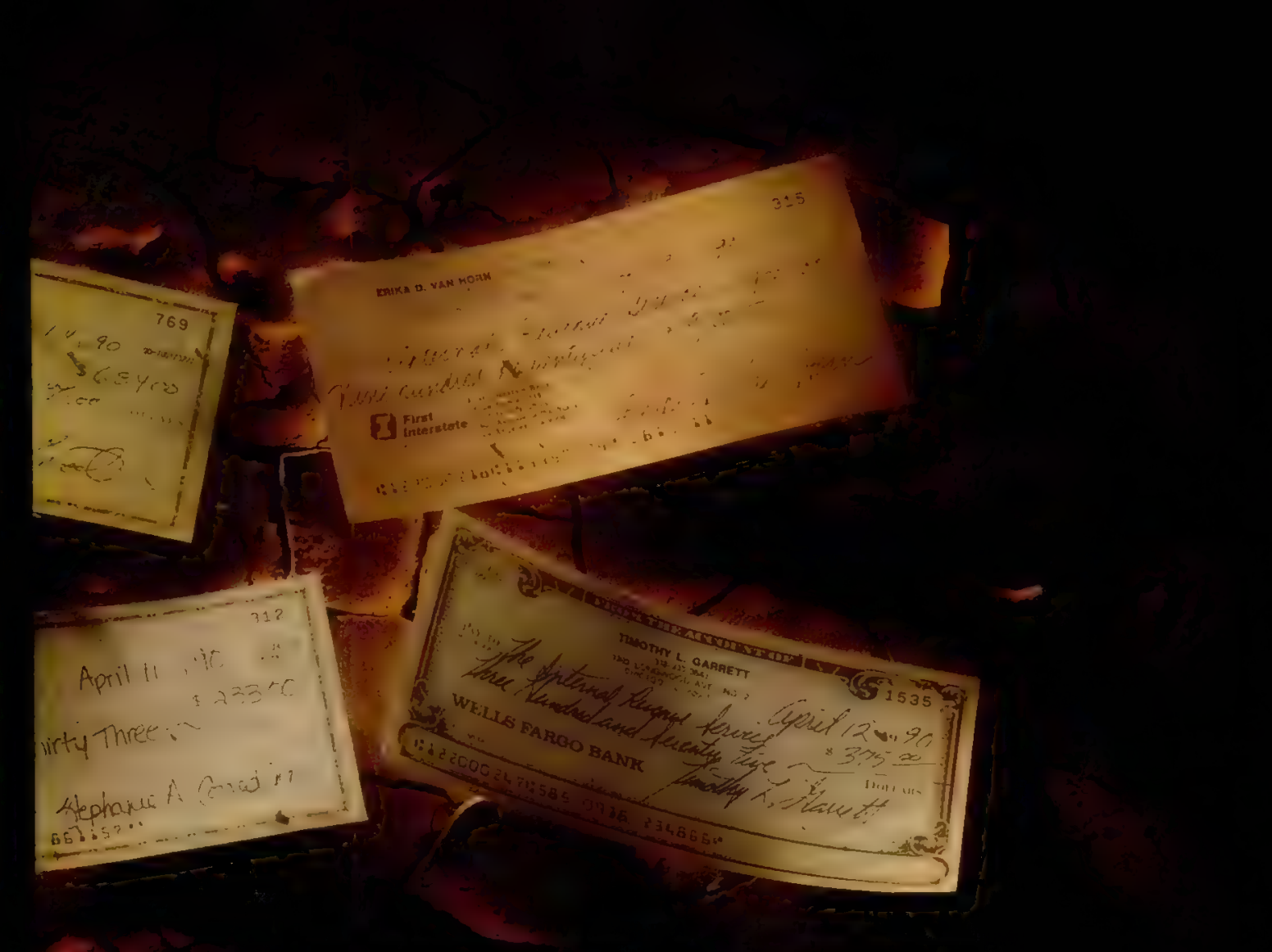

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calculations are done for you in under 5 seconds. TurboTax can print out graphics quality forms on most dot matrix and laser printers. Then, just sign your return and mail it in right off your computer.

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Ask about the family of ChipSoft products including 44 Interfaceable State Programs and our Electronic Filing Software.

You'll find out why more than 3 million returns were prepared with TurboTax last year alone. Or, for that matter, why more PC users use TurboTax than any other tax software.

Then next time taxes roll around you'll have something completely new to give the IRS.

A run for your money.

CIRCLE 348 ON READER SERVICE CARD.

Tax Software

CONTINUED

you still need to get the Form 8453 by mail to the *Your Income Tax* transmitter, (the TenKey unit, located in Orlando), so that they can proceed to forward your electrons to the Internal Revenue Service.

Using a Hewlett-Packard laser printer and the free soft fonts you will get by mailing in the postcard that comes inside the shrink wrap of the package, you can print out slick, precise, and professional replicas of Form 1040 and the supporting schedules. On a dot matrix printer, *Your Income Tax* prints an IRS-acceptable graphics 1040 with the rest of the forms in Courier typeface.

There are state tax programs available for 24 states (at $29.95 each) that pick up data from the federal program and then arrange it in the state return format. Then you can make any individual modifications that your home state requires.

J.K. Lasser's Your Income Tax typifies the trend toward ease of use and beautiful output (on appropriate equipment). It lacks some of the all-encompassing features of *TurboTax* or *TaxCut*, but the strides that have been made with its recent redesign bode well for the future of this excellent program.

List Price: *J.K. Lasser's Your Income Tax*, $74.95. State programs, $29.95 each. **Requires:** 512K RAM, hard disk with 3MB of available space, DOS 2.1 or later. Simon & Schuster Software, 15 Columbus Circle, 14th Fl., New York, NY 10023; 800-955-8291.

CIRCLE 425 ONREADER SERVICE CARD

PC MAGAZINE EDITORS' CHOICE

- **Andrew Tobias's Taxcut**
- **TurboTax**

In the last issue, we selected *Andrew Tobias's TaxCut* from Meca Software, and *TurboTax* from ChipSoft as Editors' Choices. Among the packages reviewed in this issue, *AM-Tax*, from AM Software, delivers competent functionality in a back-to-basics setting. *J.K. Lasser's Your Income Tax*, from Simon & Schuster, offers excellent output and a copy of a classic book on tax preparation for the individual. *MacInTax for Windows*, from Softview, brings tax preparation into the graphical world of *Windows* 3.0.

While these programs all have their strengths, none of them can match the overall excellence and comprehensiveness of *TaxCut* or *TurboTax*: Both of these make tax preparation a much less taxing task.

MacInTax For Windows

From its red, white, and blue top-hat icon in the *Windows* Program Manager to its uncannily realistic on-screen depictions of IRS forms, *MacInTax for Windows* looks like a whole new world of PC tax software. It is. Designed to run under *Windows* 3.0, *MacInTax* requires a mouse and, like most *Windows* apps, begs for the extra muscle of at least a 386SX processor. As its name suggests, it is based on a sibling program that has been virtually the only tax return program for the Macintosh.

You can begin working with *MacInTax* in the Forms Guide, which is the equivalent of a checklist or an interview. An affirmative answer to an interview question brings up the proper supporting form for completion there and then. If you prefer to plunge right into the Form 1040, you can use the *MacInTax* linkage feature to summon the appropriate supporting form for any line that needs one. Double-clicking on the entry field of a line in a form pops up the supporting form. Double-clicking on the description of an entry line brings up an instruction window.

The program recalculates automatically after each entry, and you can take advantage of the *Windows* environment to watch this at work. Try going to line 13 on the 1040, for example, and then link to Schedule D, which details your capital gains. Next, size the Schedule D window to keep line 13 of the 1040 window in sight. Finally, watch your entries on Schedule D show up as a part of the new total on line 13 of the 1040.

While *MacInTax* genuinely exploits the look, feel, and power of *Windows*, at times it falters as tax preparation software. You'll find references in the manual to instances where you need to intervene to apply a limitation, as you do when working with the $10,000 annual expense limit for new assets. If you use it for more than one Form 4562, the documentation advises, "you must manually ascertain that you have not taken more than the allowable limit." There is simply no reason why the software couldn't do that for you. In addition, there are no overrides of any field that *MacInTax* calculates automatically. Other tax preparation programs have long provided this capability.

MacInTax for Windows tax help screens are fairly basic, sometimes picking up the IRS instructions without even minimal editing to eliminate the cross references to pages of the IRS publication that don't exist in the *MacInTax* presentation.

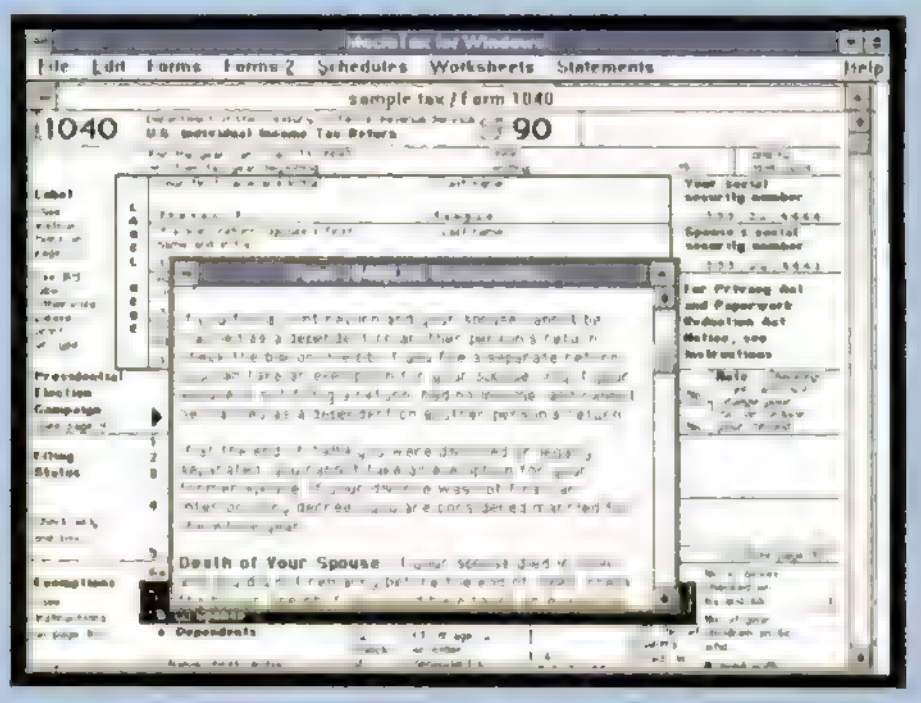
The excellent printing features include a spooler and downloadable soft fonts that produce professional-looking replicas of all of the program's IRS forms on Hewlett-Packard LaserJets and compatible printers. No special font cartridge is needed.

Compatible programs are available for 13 states. *MacInTax* generates a data file that you can mail (along with the $29.95 fee) to a company called Speed>S, in Minneapolis, for electronic filing. To apply for a refund anticipation loan, there is a $39.95 fee for a minimum RAL of $300 and a maximum of $3,000, from the Greenwood Trust.

In general, it seems that the *MacInTax* people did not attempt to take advantage of their years of Mac monopoly to improve the *MacInTax* program as aggressively as they could have. That may be because Mac users had no other choice, but with *TurboTax* now available in a Mac version, and with a Mac version of *TaxCut* in the planning stages, the market is getting more crowded.

For the confirmed *Windows* fan, *MacInTax* is really the only game in town, at least for the moment. Despite the software's limitations, the WYSIWYG screens and terrific output native to the graphical environment are pretty powerful incentives for trying *MacInTax for Windows*.

CONTINUES



MacInTax for Windows **has help screens that pop up over the program's beautiful depictions of IRS forms.**

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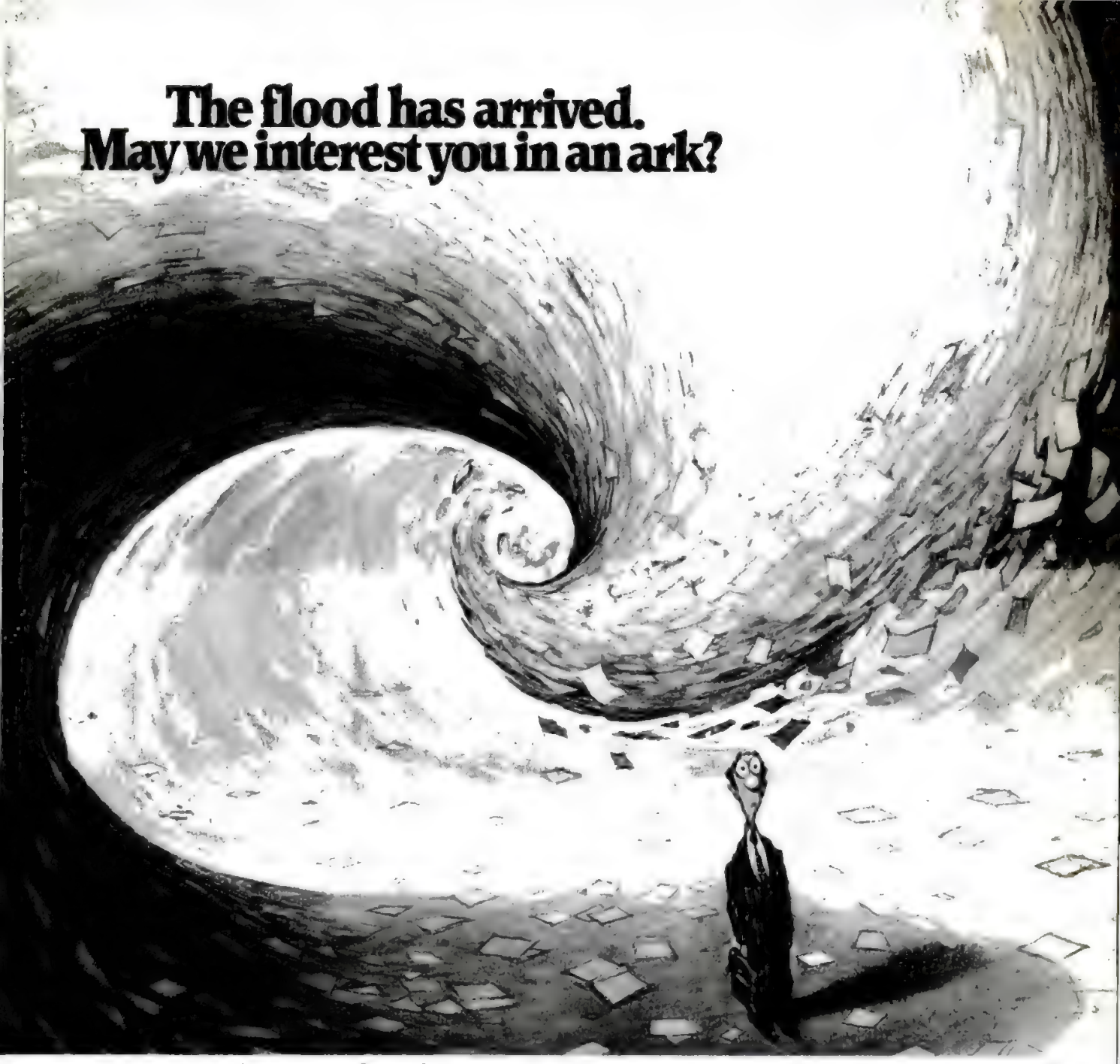

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Tax Software

CONTINUED

List Price: *MacInTax for Windows*, $99. State programs, $69. **Requires:** *Windows* 3.0, mouse. Softview Inc., 1721 Pacific Ave., #100, Oxnard, CA 93033; 805-385-5000.

CIRCLE 426 ON READER SERVICE CARD

Personal Tax Preparer

Parsons Technology's *Personal Tax Preparer* looks good as you fire up the menus and move to the interview questions. The promises of the direct mail ads seem almost within reach. Deep discount software that does everything the leaders do, only cheaper!

Soon you notice that many of the questions are phrased in a mildly confusing, backhanded fashion. Questions that cover straightforward, mainstream issues require second thoughts. Even this early in the process, you may start to have second thoughts about this software. Filing your return is tough enough without the frustration of feeling that your software dwells on peripheral details and fails to illuminate the main issues.

When you give the Quick Entry feature a try, you encounter the usual questions, occasionally phrased to depend on answers that you hoped the program would provide. These questions may not lead you to make any actual mistakes, but they have a rote, inarticulate quality that does not inspire confidence.

With my test scenario, the beta version of *Personal Tax Preparer* fluffed the underpayment penalty, the depreciation limitation for listed property, and any effort to deal with tax shelter passive losses.

The cumulative effect makes you wonder how many of the carryovers, cross-references, and automatic calculations the *Personal Tax Preparer* actually does and to what degree the program merely shows you a form and then leaves it up to you to go chasing after the entries.

Movement between screens is excruciatingly slow. Recalculations take forever and are often obligatory before you can move from one task to the next. The limited on-screen tax help is primarily brief undigested basics or lists such as IRS-recorded tele-tax phone and topics numbers or lists of IRS publications to request by phone and receive by mail.

On the positive side, there is a smooth-working depreciation calculator that works for normal assets and has a helpful "suggest" key, F8, that lists the principal choices for most elements. You will need to do further computations on your own for assets with limitations on the usual depreciation formulas (such as automobiles and computers subject to the listed asset restrictions). After the program calculates the amount of the depreciation deduction, you need to enter it on the appropriate forms yourself.

There is a financial calculator that gives you a printout of monthly payments when you provide the other elements of an annuity or mortgage payment obligation, though the financial calculator that comes with *J. K. Lasser's Your Income Tax* is more complete and more flexible.

The *Personal Tax Preparer* print option is a basic Courier typeface that may be IRS-approved in the final edition. There are no state programs.

Unfortunately, *Personal Tax Preparer* offers neither the state-of-the-art design of industry leaders like *Andrew Tobias's TaxCut* and *TurboTax* nor the streamlined "get it done" efficiency of more-modest packages like *AM-Tax*. ■

List Price: *Personal Tax Preparer*, $49. **Requires:** 512K RAM, either two floppy disk drives (one of which must be at least 720K) or one floppy disk drive and one hard disk, DOS 2.11. Parsons Technology, 375 Collins Rd., NE, Cedar Rapids, IA 52402; 319-395-9626.

CIRCLE 427 ON READER SERVICE CARD

Much of the scanty help available in Parsons Technology's *Personal Tax Preparer* simply refers you to other sources.

PERSONAL VERSUS PROFESSIONAL TAX SOFTWARE: For Average Filers, The Differences Are Minor

by Laura Lou Meadows

Many personal tax software publishers also market packages aimed at professionals. Do the professional tax programs know anything that the personal ones don't? On the whole, not really. Personal tax return programs do virtually the same job, although the professional programs may cover some additional forms and schedules that are less frequently needed. Some professional tax programs also have worksheets that take care of a few more subsidiary calculations and transfer the results to the proper IRS forms.

Other than the professional designation and the price, however, the main differences between the two categories are the batch input features and the administrative and printing support tax pros get from the professional programs. Batch input means that a data processor, innocent of all tax knowledge, can be trained to type in a taxpayer's data from handwritten input sheets filled out manually by a tax pro, usually during a face-to-face interview with the taxpayer. The input sheets are often printed out by the program with numbered questions and blocks for the answers that correspond to numbered entry lines in the computer program.

In offices with less computerphobic tax professionals, the specialists are likely to feed the data directly into the computer themselves.

Other differences between the personal and professional programs are in the administrative documents, such as client bills and client letters.

Finally, the professional programs have more and better printing options. With laser soft fonts or tax font cartridges, and libraries of laser drivers containing the official forms, the professional tax programs print precise replicas of most of the government forms.

This year, *TaxCut* includes a taste of this spiffy printing capability for 15 federal forms—including the 1040—in the cost of its personal program reviewed here and, for another $99, will sell you the laser soft fonts and drivers to print the rest of the forms the *TaxCut* package contains. ■

by Bill Howard

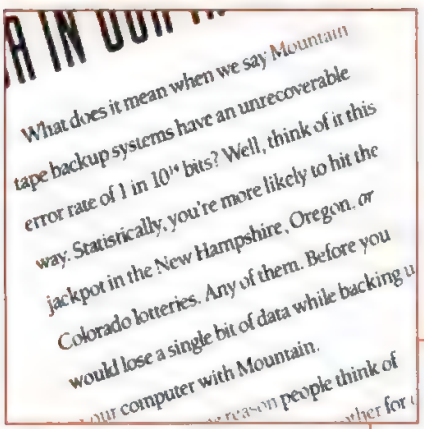
Abort, Retry, Fail?

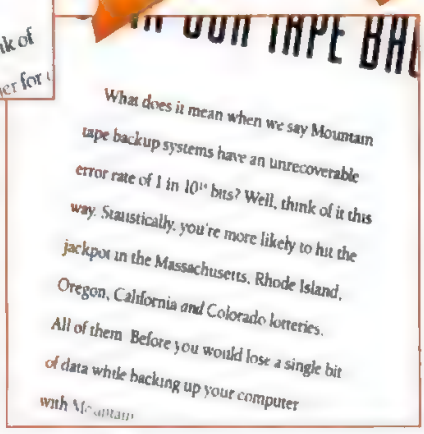
The Lighter Side of Personal Computing

What's Behind the Popularity of the PS/1

"The [IBM PS/1] computer's brain is composed of a chip called the 80286. Disk-operating-system software that performs routine computer operations is stored on a chip inside the machine, dispensing with the need to learn how to use the software."
—*Tampa Tribune*, June 27, 1990

Memory expansion we've heard of, but *a floppy disk drive that expands from 1.2 MB to 1.44 MB?* That's the claim the Office Club (Albuquerque, NM) makes for the Arche 386-25 PC.





Tale of the tape: Last fall, Mountain Computer said "You're more likely to hit the jackpot in the Massachusetts, Rhode Island, Oregon, California, and Colorado lotteries. All of them," than lose a single bit of data with a Mountain tape backup. This year, Mountain says, "you're more likely to hit the jackpot in the New Hampshire, Oregon or Colorado lotteries. Any of them."

"Canon Bubble-Jet Printer.

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—Tenex Computer Express, fall 1990 catalog (200 million characters equals 100,000 pages. An average cartridge will yield maybe 1,000 pages.)

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness and completeness of entry are considered. Winners this issue: David Rolfe (Mountain backup), James E. Campbell (1.2 MB expandable to 1.44), Dave Rhodes (Canon ink cartridge), Fred Dunayer (PS/1 learns software for you).

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5. How many PCs do you have installed now at your company?
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☐ 386-based systems ☐ Laptops
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5. How many PCs do you have installed now at your company?
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DELL COMPUTER CORPORATION

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(CONT'D FROM BACK PAGE)

Our new 386's pull a fast one on pricier computers. Both the 33 MHz Dell System® 333D and 25 MHz Dell System 325D are faster and more expandable than most higher priced systems.

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Then you get 30 days to use it. If you aren't satisfied, send it back. We'll return your money, no questions asked.

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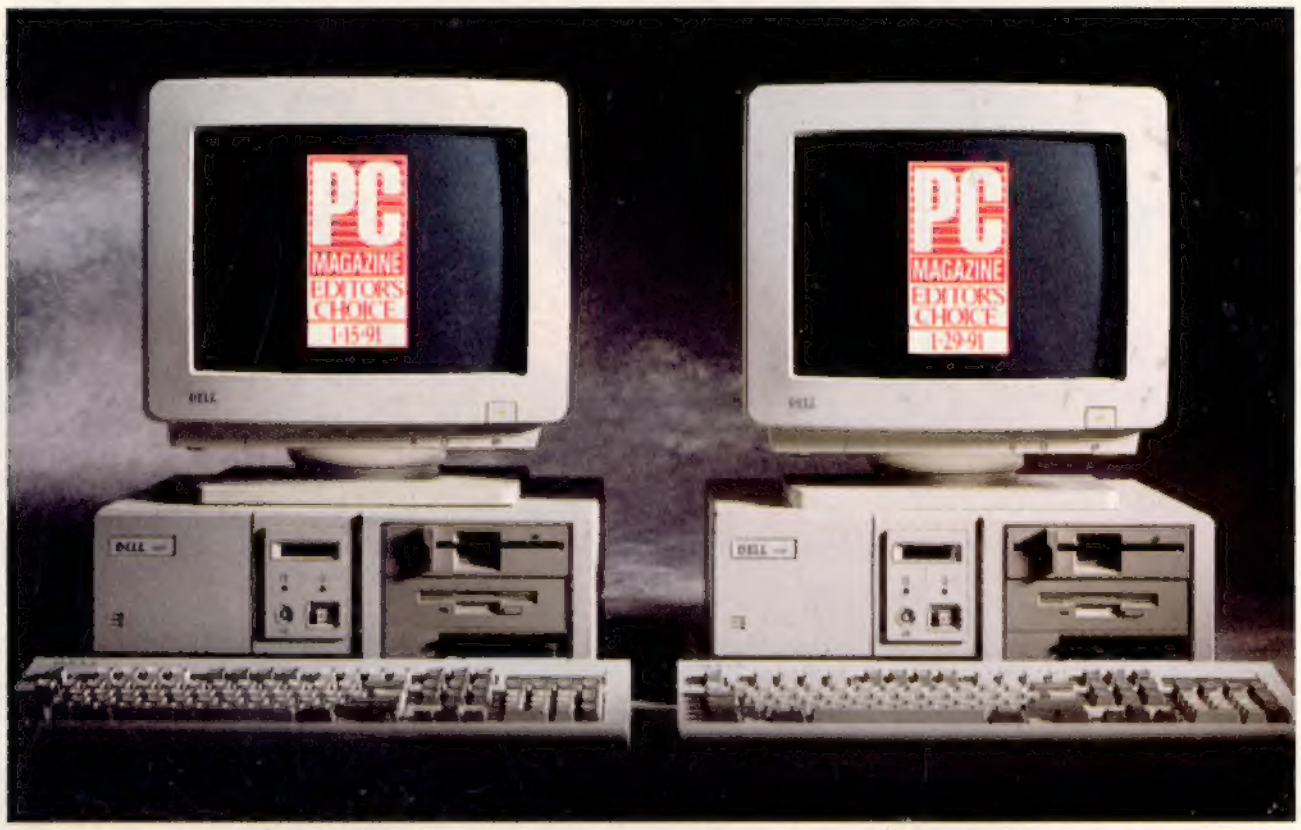

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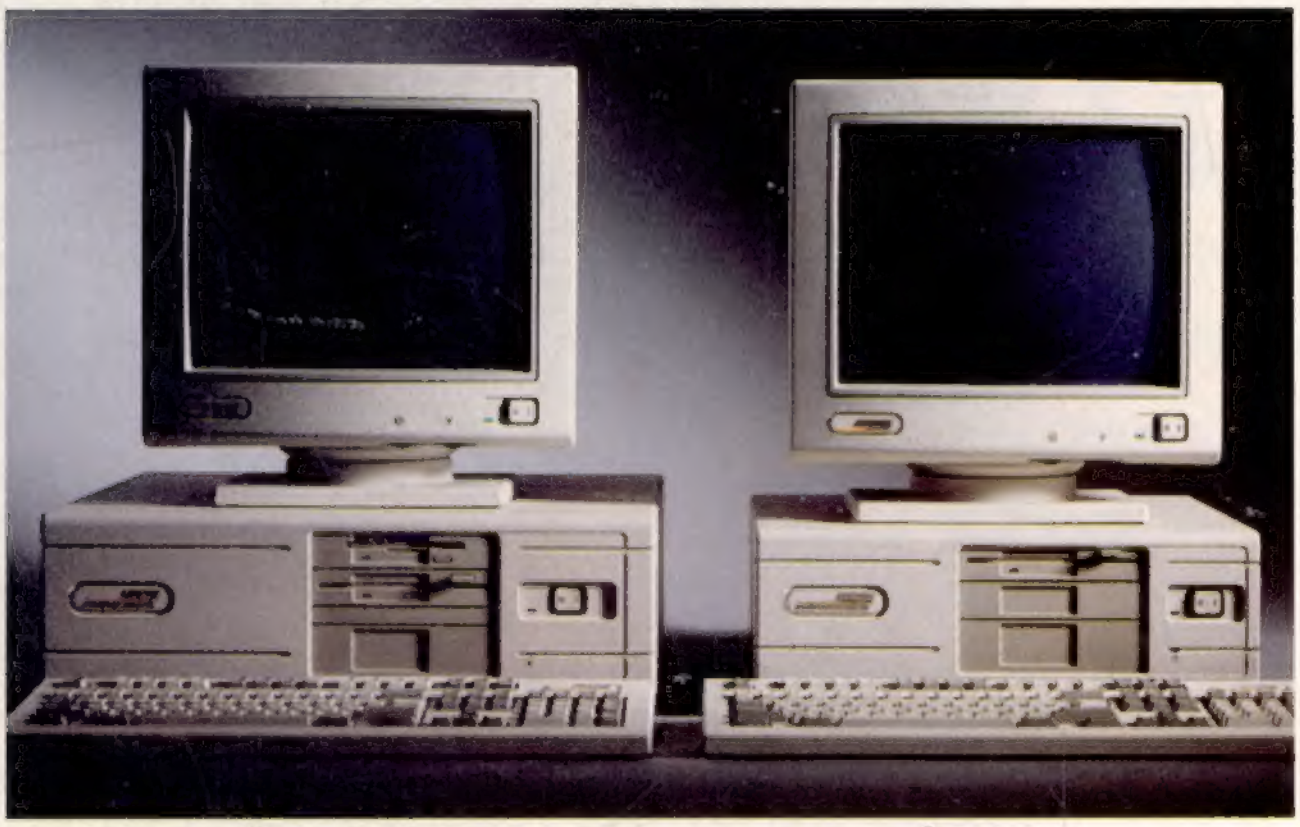

$10,699†
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So what do you get by paying the extra mark-up for a Compaq?

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In fact, the only thing extra you get from Compaq is, well, mark-up. For more details, look inside.

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